Pit and Quarry

SAND-GRAVEL-STONE
CEMENT-LIME-GYPSUM

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Pit and Quarry

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MISSISSIPPI FLOOD NOT IMMEDIATELY DAMAGING TO NATIONAL BUSINESS

IT IS impossible to view the utter financial ruin which the floods have brought to thousands of individuals in the lower Mississippi Valley without feeling that all of this loss of past savings and of apportunity for work must have a damaging effect upon the business of the entire nation. That it has had and will have, it would be idle to deny. A curious point and one that is overlooked however, is that for the immediate future its effect will be to stimulate business. True, it has destroyed the capital and the livelihood of thousands. That point must be given due weight. Nevertheless, it is equally beside the point to fail to realize that after every catastrophe based on natural causes, we have the human reaction to repair the damages.

The nation is like a man climbing steeply to a goal. He slips back occasionally but because of that very slip he redoubles his efforts to make up for the time and distance he has lost. We have lost time and distance in our accumulation of wealth, but the loss is relatively small in relation to the total for the nation. It has, however, been large enough and keen enough in the human suffering involved to stimulate the country as a whole to just a little greater effort to repair the losses involved. For the individuals directly affected, the rebuilding activities may never compensate for the losses. But business history fails to support any idea that local damages from flood, fire, earthquake or even war are necessarily damaging to business outside the affected area.

For example, the San Francisco earthquake and fire came early in 1906, one of the greatest years of business activity and of business prosperity ever seen by this country. It might be argued that the effect of this disaster was simply absorbed by the overwhelming tide of prosperity. But if that is true the same situation exists today. The more recent Japanese earthquake offers in the study of our trade with Japan undoubted proof that in the first year following an economic disaster of this type, the inhabitants of the affected region buy enough, directly or on credit, from the rest of the world for the reconstruction of their destroyed property, so that this item overbalances their decrease in purchases for current use.

Certainly the destruction of capital involved in such disasters cannot be reckoned a b'essing. But that affects the longer view, the rate at which we arrive at a fuller measure of well-being. It is true that the destruction of capital in San Francisco was one of the minor elements which brought on the panic of 1907. It is undoubtedly true that the borrowings of the Japanese for rebuilding after their earthquake has been a vital factor in the current bank panic of that country. In both these cases, however, capital was being actively employed in other directions, and the new demands made for extreme stringency. At the present time the situation in the United States is one of superabundant capital seeking some kind of employment. To a very great extent this excessive capital is now being used in the very unproductive operation of bidding up the prices of old securities. Or else it is being used for the expansion of plants and industries where productive capacity is already so far ahead of current output and consumption as to make the addition of new plants an exceedingly doubtful investment.

The rest of the country has already given a few million dollars to the flood sufferers. It will have to loan them sums to be measured in the hundreds of millions. If the supply and demand of capital were closely balanced, this withdrawal of funds from other activities might handicap business throughout the country. With the supply of capital so far in excess of current demands, the expenditure of this new capital in rebuilding the flooded districts may be regarded as an entirely new addition to construction programs for the coming year. It will more than offset the current damages of the flood and may tend to correct the dangerous speculative activities which are developing in many fields.

AUTOMOBILES AND PROSPERITY

SOUNDS of woe are coming from many of the business prophets. The automobile industry is headed for disaster. It has become our key industry and its inevitable disaster will shake the business of the country to its foundations. There is something and quite a little something to be said on the other side. Let us assume that automobile productive capacity has been built to a point far beyond any reasonable prospect of demand. Let us assume that the competitive situation is causing the margin of profit in many cases to become non-existent. Let us also assume that as a result of huge integrated units, marvelous efficiency and high output with relatively low production costs some of the larger companies are not making the path of the smaller maker any too smooth. When all this is assumed and granted we come to the conclusion that the lot of many automobile companies this year is not going to be a happy one. It does not follow that total output of cars is going to fall off so sharply as vitally to affect employment and the demands of the industry for materials.

The view of disaster to business from the automotive industry is due to a misconception of the place of the industry in our economic life. The automobile industry is not so much a cause of business prosperity as it is an effect of it. This flies in the face of the assertion that the industry is no longer in the luxury class; that it is a handmaid of business primarily. This latter assertion may be granted but it would be interesting to watch the effect on the automotive industries if present capacity had to be supported only by the utilitarian demand for cars. It is still the pleasure and luxury —the social demand for cars which is the marginal at least and the dominating force in the prosperity or lack of it in the industry. As long as the wealth and income of the American people keep increasing or even stay at present levels the number of cars put out and the consequent demand for labor and materials are not going to suffer any decline.

As long as the present state of well-being continues a replacement demand for three million or more cars is going to be there. As long as labor continues to make high wages and add to the consuming power of the country, the social asset of a car will add to the ranks of new buyers. Marked diminution in car buying is going to come from economic conditions outside the automobile industry, not from its internal developments.

RECORD GENERAL PROSPERITY

EVERY one knows that the last few years have been ones of decided well-being for the average individual in the United States. Even when one gives full recognition to that fact the figures which measure it are amazing. The National Bureau of Economic Research have recently published careful estimates of the annual increase in national income since the war years. The American people in 1926 had an aggregate income of nearly ninety billion dollars as compared with sixty-three in 1921, an increase of 43 per cent in five years. With an average of over two thousand dollars a year for every person gainfully employed the American worker has arrived at the highest pitch of prosperity he has ever enjoyed. This latter statement allows fully for changes in the price level which have occurred since the beginning of the World War.

This astounding increase in income has put him in command of luxuries not dreamed of a few years ago. But the resultant reaction on various industries has been curiously unlike. Why is it that luxury lines in general are prosperous while what might be considered essential lines are on the whole in relatively poor condition? Textiles, clothing and most food lines cannot be said to be revelling in luxury.

Several learned treatises could be written to supply the answer. No particular remedy can be given here. But there can be outlined some of the conditions which exist and better minds may find the solution. In the first place what an individual can or will spend for necessities is rather limited. He cannot very markedly increase his consumption of food or very decidely add to the amount of clothing he wears. He can improve the quality but not greatly the amount. Against this we have in most essential industries an output or capability of output far in excess of the slightly augmented demand of the prosperous individual.

This is one part of the answer. From it however many things flow. The resultant competitive situation brings about the offering of terms and services to attract new buyers that speedily become ruinous. The term service is used here in a rather broad sense. It includes the assumption of the added expense necessary to make and ship in small quantities. It is no answer to say that is the only way the buyer will buy. That brings us back to the first fact that the buyer could not do it if the productive and consequent competitive situation were not as it is. Imagine a buyer getting the kind of small lot service he is getting now during the war years.

Space will not permit tracing numerous other results that accrue from the same situation. In his desire to get an order the producer in most basic lines is arriving at a stage where increasing competition is bringing about the anomaly of raising prices. Either that or it is leading him into insolvency.

REBUILT PLANT BRINGS NEEDED ECONOMIES FOR ELKHART SAND AND GRAVEL COMPANY

ELKHART LAKE, Wisconsin, has for many years taken pride in the fact that the Elkhart Sand and Gravel Company was an important factor in the sand and gravel industry. This company built their first plant in 1912 and have since built and operated a number of separate plant units all of which, except pits number three and five, have since been discontinued.

While they have for fifteen years operated plants in these different pits, the best deposit was found to be in pit number five, where a large plant was built in 1917, at that time rated to handle a capacity to average 20 cars per day, based on 2½-inch product, which was most in demand in those days. In later years, however, the output from this plant dwindled to an average of 10 cars per day, because the original crushing equipment was inadequate for the production of 1 and 1½-inch stone, which was far more in demand than the 2½-inch or coarser product of earlier years. This condition was aggravated by equipment and machinery getting old and worn out and because in this plant additional crushers could not be added without extensive alterations.

At the close of the 1926 season therefore, serious consideration was given to improvements for this year and several plans were investigated carefully. The one at first most favored was to repair all of the original equipment, add additional crushers and change the excavating method from power drag scrapers to steam shovel and car hauling system. To give a better appreciation of the conditions, it is well to give a brief explanation of the old layout.

Storage bins were located along a spur track of the Chicago, Milwaukee and St. Paul Railroad which parallelled a 50-foot high bank of gravel. At the base of the hill was located a receiving hopper into which the aggregate was deposited with power drag scrapers. From the hopper it was fed with a steel apron feeder to a 30-inch continuous bucket elevator, to a sizing screen, installed parallel to the elevator, with the discharge end pointing back to the hopper, set at the edge of which was located a Champion number 55 crusher, returning its crushed product to the receiving hopper.

The product passing through the scalping screen was fed to a 24-inch continuous bucket elevator, placed directly in line with the initial elevator, conveying it to top of bin for washing and grading on a 4-deck shaker screen and sand settling tanks.

A one cubic yard Sauerman scraper was used to excavate, as the hill was high and the haul short, and from time to time the excavating unit was moved on into the pit and horizontal belt conveyors added to convey to the original receiving hopper. A photograph of the old plant is shown, which was taken shortly after the first field conveyor was extended into the pit about 150 feet.

When a careful check was made last fall on the cost of repairing the old equipment, it was found that the cost would be excessive, additional crushers needed could not be conveniently added to the old arrangement and considerable belt conveyor

This Shows the Old Plant Before the Changes Were Made as Described in the Article

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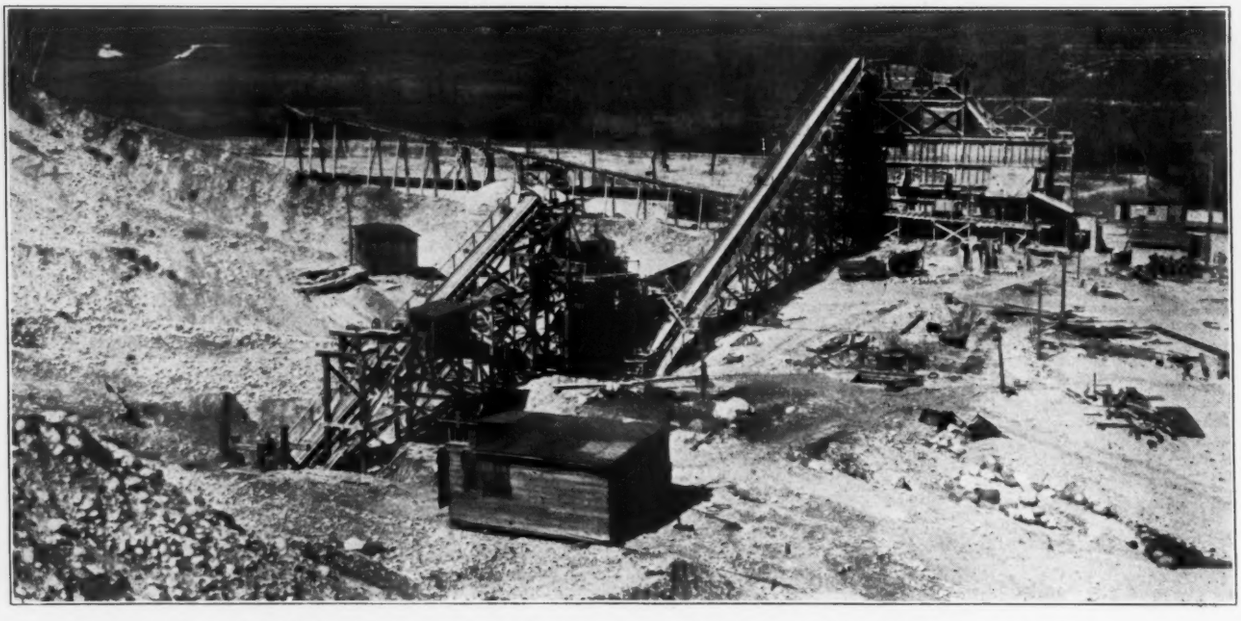
Showing How One Portion of the Pit Has Been Worked With the Scraper

equipment in good condition and with practically new belt would be entirely discarded. From several plans submitted, contract for entire rebuilding of the plant was awarded to the Bakstad Machinery Company, whose plans made it practical to use the present scraper equipment, belt conveyors, transmission, etc., which would have been discarded in changing to steam shovel and dump car system.

The plan accepted called for complete dismantling of the old equipment, leaving the old storage bin only as before, it being stripped of its superstructure to a level with the top of bin. Its size was 20 feet wide by 80 feet long by 30 feet high above the foundation. The original receiving hopper and elevator was located at the north end of the bin, from which point a 150 feet long field conveyor was extended, thus working a sweep on a radius of approximately 300 feet from the hopper. A second field conveyor, 175 feet long, was added later and several years' additional output was removed from the deposit to the north, which procedure would have been extended to the deposits east and south of the bin, except for the limitations already mentioned.

In planning the new layout, therefore, the most advantageous location for the receiving hopper was found to be directly at right angles to the south end of the bin, or about 300 feet east, which would make it possible to use the old power scraper equipment to excellent advantage on a short haul, during the remainder of its useful life and before necessitating extensions with field conveyors. By digging down at the base of the gravel bank a new



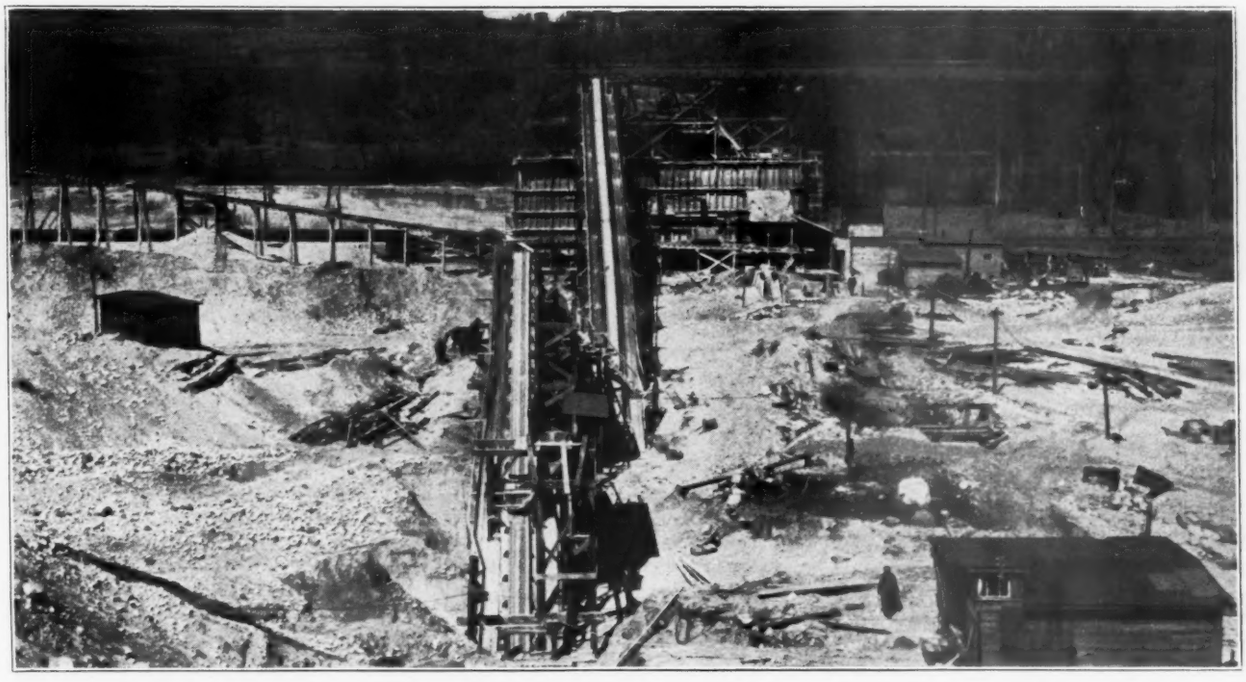
View of the Rebuilt Plant Showing Conveyors to Crusher First and then to Screens and Bins

This View Shows in Good Detail the Timber Construction of the Rebuilt Plant

receiving hopper was built as the starting point.

The original steel apron feeder was rebuilt to practically new condition and installed under the hopper. From the feeder a 30-inch inclined belt conveyor carries the pit run to a point approximately 33 feet above the pit floor, which at this point is 6 feet lower than the base of the bin. With only a 4-foot offset and in straight line with the conveyor the pit run is passed through a 60-inch diameter by 20 feet long scalping screen, below which the crushers are grouped and arranged to feed onto another inclined belt conveyor for return to the hopper.

The scalping screen is provided with both 1½ and 2½-inch perforations, so that with a flap gate arrangement below, the 2½-inch size may be fed to the crushers when a run of 1½-inch product is desired, and additional plates are provided and on hand to provide for a run of 1-inch product, when required. As the percentage of aggregate requiring crushing runs very high in this pit and to provide for the increased demand for finer product, three crushers were provided in the crushing unit below the scalping screen, arranged so that the plant may be operated with all three or any one independently. Two of these crushers were already



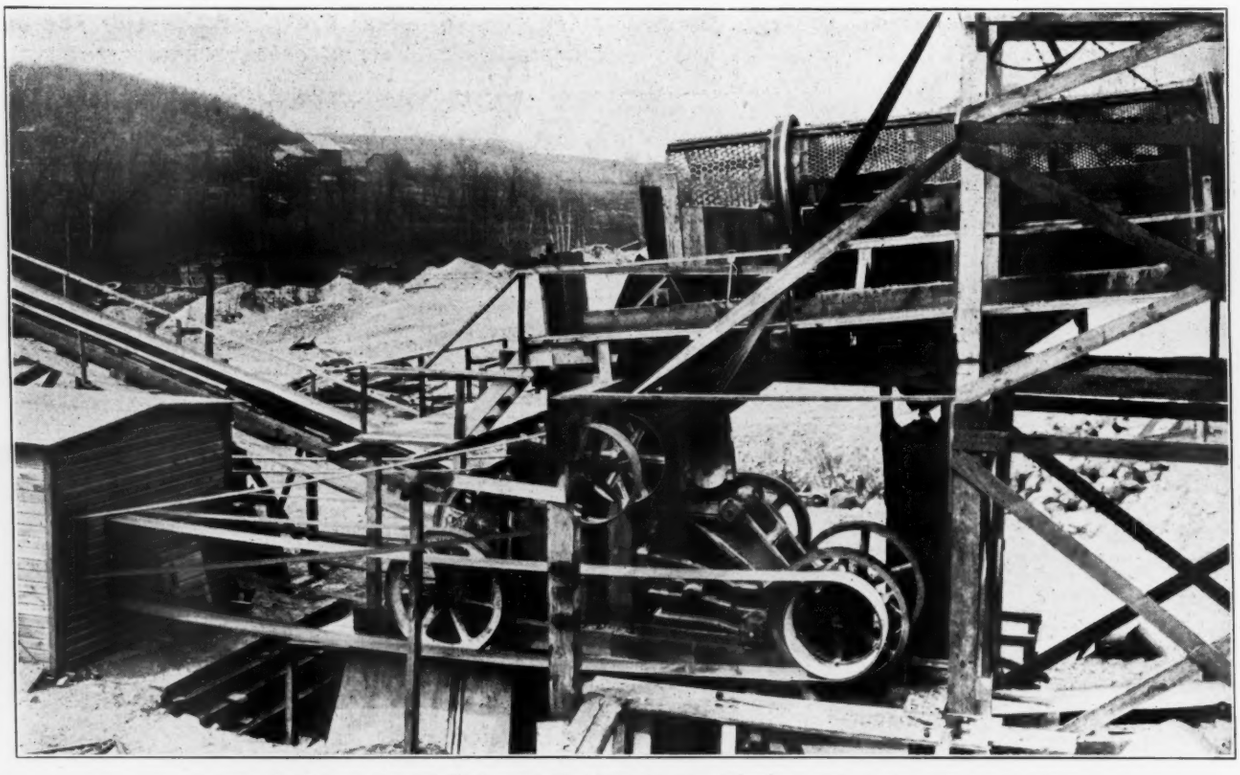
A Straight Line View of the Conveying Units

Excellent General View of the Deposit and Plant

on hand, a Champion number 55, used in the old layout in this pit, and a Champion number 6 taken from one of the smaller plants in a pit closed down a year ago. The third unit is a Bakstad patented 3-jaw crusher, which is unique in that it makes primary and secondary reduction in one operation.

The main conveyor to the plant, located at one side of the scalping screen and crushing plant, is 30 inches wide and 200 feet long and carries the material to a point 22 feet above the bin, at the south end, and feeds the washing and grading screen, which is 60 inches in diameter by 200 feet long and provided with an outer jacket 7 feet in diameter by 12 feet long. This screen is also of the open type on rollers, with the washpipe entering at the discharge end, having a number of nozzles throughout its length and an extension adding wash-water to the chute from the conveyor.

Two 5 feet by 20 feet flight conveyor type sand washers and separators are located below the screen, with the discharge point above the first compartment on the south end (reversing the order of the old layout). The screen is equipped to separate sand, two sizes of roofing gravel and 1-inch stone, whereas 1½ or 2½-inch stone, depending on the size of product by-passed at the lower screen,



Close Up View of the Crushing and Primary Screening Plant with Return Belt at Left

The Main Screening and Storage Unit is the Building at the Right

passes entirely through the washing screen. A compartment for pit run gravel, sized 1, 1½ or 2½-inch in the lower screen, is provided directly under the conveyor discharge and may be quickly filled by removing a section in the chute, and likewise any desired combination of mixed stone may be made below the screen. This is simplified materially by the use throughout the plant of "Strenes" metal sectional chutes, as manufactured by The Advance Foundry Company.

All of the equipment in the old plant was operated through line shafts with a General Electric 150-horsepower motor located at the base of the plant, except one of the field conveyors which was operated with a separate motor. This 150-horsepower motor, with the original line-shaft, is now furnishing power for the crushers, scalping screen, initial feed conveyor and the apron feeder, and practically all drive connections were made with transmission parts from the old plant. A 50-horsepower G. E. motor, formerly operating the plant discontinued last year, was installed in a motor house on the top of the plant to furnish power for the washing screen, sand separators and main conveyor, where also a share of the transmission parts were taken from the old installation.

The two field conveyors formerly used were furnished by the Bakstad Machinery Company and rebuilt to suit the present installation, except the return conveyor from the crushers, which was taken from one of the older pits, now discontinued. The excavating unit is a Sauerman "Crescent" power scraper and hoist, electrically operated. No changes were made in the pumping plant. Bakstad Machinery Company, who designed the new plant arrangement, also built and furnished, in addition

Crushing Plant Is at Right and Material Is Taken by the Long Conveyor to the Screening and Storage Unit at Left.

to the 3-jaw crusher, the two 60-inch by 20-feet long screens, the two 5-feet by 20-feet sand separators, additional transmission required and the "Strenes" metal chutes.

The old plant was dismantled at the close of the 1926 season during the latter part of November, prior to which time the foundation plans for the lower plant were prepared so that foundations were in before any delays were experienced by snow or frost; the old equipment again to be used was overhauled during the winter months and new structural work and installation of equipment was started in the early spring. The new plant was ready for operation on April 15th, taking care of a daily production averaging 20 cars.

Astonishing "Incidental" Accident Costs

Talk to any progressive executive and he will agree that accidents are costly. He may even bring forth figures arranged to show his annual outlay for accident toll. So far as they go these figures may be correct, but in practically every case they represent only a small fraction of the total cost of industrial accidents.

Recently a large insurance company compiled an analysis of 5,000 specific accident cases drawn at random from its files—with astonishing results! It was found that the indirect or "incidental" costs, paid by the employer himself, is four times the total cost represented by compensation and liability claims, and medical treatment. That is to say, while a protective policy might impose the latter costs on an insurance company, four times this amount must come out of the employer's pocket—because of "incidentals."

Here is how. Excluding all direct costs which do not have to be paid by the employer, industrial accidents result in the following costs:

1—Cost of injured employee's lost time.

2—Cost of lost time by other employees who stop work out of curiosity or sympathy, to assist injured employees, etc.

3—Cost of lost time by supervision and executives, distributed as follows:

a—Assisting injured employee.

b—Investigating cause of accident.

c—Arranging substitute worker's transfer, etc.

d—Selecting and training new worker to replace injured one.

e—Preparing state accident reports, etc., or attending claim hearings.

4—Cost of time of first-aid staff, when such is borne by company.

5—Cost of injury to machine, tools, or other physical property.

6—Incidental cost due to failure of department to deliver on time. thereby disrupting schedules.

7—Cost to employer in continuing wages to injured worker who returns to work while not fully recovered and is only 50 per cent of normal productivity.

8—Cost due to loss of profit on injured employee's productivity and on idle machinery and equipment.

9—Cost due to reduction in output or quality of work by fellow employees because of lowered morale due to accident.

These are but some of the items that go to make up secondary or incidental accident costs. Serious cogitation of these points should impel many employers to take immediate steps to eliminate every possible accident hazard. There is a financial as well as moral reason.

Making of Asphalt Macadam Pavements

It seems that the great end to be desired in a roadway surface may be defined as the economic attainment of permanent smoothness. To attain this (a sufficient supporting base and edge protection being given) the wearing coat of non-monolithic roadways should be smooth on completion, should resist disintegration, should resist flow within its body, should resist sliding on its base and should resist surface abrasion, the last implying the corollary of self-maintenance.

Asphalt macadam, as deduced by observation, largely fulfills the requirements, in that reasonable uniformity and smoothness can be obtained by careful construction; the construction and materials are economical, and when properly conjoined resist disintegration; the friction between large broken stone resists flow sliding; the elasticity and cohesiveness of the asphalt cement resists surface abrasion, and as used in asphalt macadam it oxidizes only on the exposed surface, and, being stored in relatively thick bodies in the stone voids, retains its qualities and acts as a reservoir of fresh material to maintain the surface smoothness under traffic abrasion and compression.

Experience with asphalt macadam construction, Alexandria, Virginia, showed many failures from insufficient base support, and edge failures on roads not backed with paved gutters.

Failures from raveling, surface disintegration, marked undulations and movement, unless caused by base failure, have been few. Edge disintegration has occurred where backed with earth or low cobble, and surface disintegration where earth was allowed to accumulate and remain on edges, and on work where, for economy, the asphalt content was reduced and gravel used instead of broken stone in the two top coats. The very few ravels are attributed to spots of fine material in the large stone course. The maintenance cost, except for keeping base failure to surface, has been insignificant.

SOME VARIABLES AFFECTING THE BEHAVIOR OF LIME USED IN CAUSTICIZING

By J. V. N. Dorr and A. W. Bull*

PREPARATION of caustic soda from soda ash and lime is one of the oldest industrial processes and one of the simplest from the standpoint of the chemical reaction involved. Soda ash and calcium hydroxide react to form caustic soda and calcium carbonate in accordance with the equation:

$$Na_2CO_3 + Ca(OH)_2 = CaCO_3 + 2NaOH$$

The choice of lime for carrying out this reaction has been the subject of considerable study and several papers have been published, including a recommended specification for lime for causticizing, by the Bureau of Standards, which states: "The standard of composition for quicklime for use in causticizing shall be a content of 85 per cent of available lime. Lime containing more than 3 per cent magnesia or less than 70 per cent of available lime shall be rejected as uneconomical to use. It is recommended that a bonus or a penalty of 1½ per cent of the contract price be added to or deducted from the payment for each 1 per cent of available lime above or below the standard 85 per cent."

In choosing lime for causticizing it is necessary to consider its physical as well as its chemical properties, because after the causticizing reaction has been completed the caustic soda solution must be separated from the precipitated calcium carbonate, and the ease with which this can be done is dependent to some extent on the physical properties of the lime used.

The separation of the caustic soda solution from the calcium carbonate mud can be readily accomplished by decantation, preferably with countercurrent washing of the calcium carbonate, in a series of decantation tanks. Soon after Dorr thickeners were first applied to this problem of continuous countercurrent decantation it became evident that the settling rates of the calcium carbonates produced at different plants varied widely, with a corresponding variation in the size of thickeners required to handle a given tonnage of solids. At first these variations were considered to be due principally to the use of different limes, but recent experiments indicate clearly that a number of other factors may be of great importance.

Among the factors which are considered to have an influence on the settling rate of the calcium carbonate sludge after causticizing are the following:

I—Source of lime.
- A. Chemical constitution.
- B. Physical nature.

II—Method of burning lime.
- A. Temperature.
- B. Length of burning period.

III—Method of slaking lime.
- A. Amount of water used.
- B. Temperature during slaking.
- C. Degree of agitation during slaking.
- D. Use of soda ash or caustic soda solutions for slaking.

IV—Method of causticizing.
- A. Period of agitation.
- B. Violence of agitation.
- C. Temperature.
- D. Excess of lime or soda ash used.

V—Causticity and concentration of caustic desired.

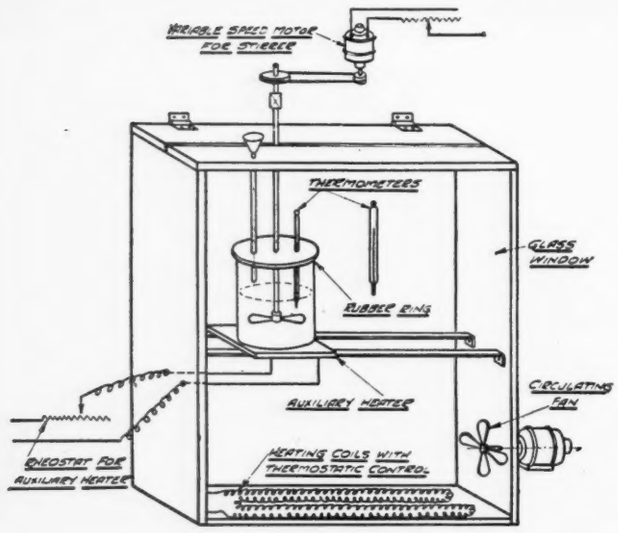
VI—Presence of impurities, particularly when reburned lime is used.

Harrop and Forrest have shown the influence of some of the factors involved. Stewart and Walmsley have given additional data, although their complete paper does not appear to have been published. Holmes, Fink, and Mathers have studied the settling rates of different limes after slaking. Recent papers by Haslam and Herman, and Haslam, Adams and Kean have shown that the time and temperature of burning have an important influence on the settling rate of the lime after hydration. Whitman and Davis have studied various methods of hydration. In considering the question of lime for causticizing it is therefore important that the many variables involved be carefully considered. It is the intention of this article to discuss the settling behavior of various high calcium limes and to show the great influence which changes in the method of slaking and causticizing have upon the settling rates.

In order to compare the behavior of lime from different sources, samples were obtained from eleven lime companies through the cooperation of the National Lime Association. Two of these samples were from Virginia, the other nine being from Pennsylvania, Georgia, New York, Massachusetts, West Virginia, Maryland, Illinois, Maine, and Texas. With two exceptions, these samples were all high-calcium limes ranging from 91.3 to 96.9 per cent calcium oxide by the sugar method, and all were standard products produced by normal kiln operation.

Experiments were first made using only one of these limes under different conditions. Later the different limes were directly compared under a standard set of conditions. The apparatus shown

*Presented before the Symposium on Lime at Richmond, Virginia, April 13, 1927.



Some Variables Affecting the Behavior of Limes Used in Causticizing

in the illustration for carrying out the causticizing reaction and for making the settling-rate tests consisted of a large box with a glass window and a thermostatically controlled heating unit. The 2500-c.c. beaker containing the solution rested on a small heating unit connected with a variable resistance. A propeller could be operated at any desired speed by the variable-speed motor, although unless otherwise specified the speed was 180 r.p.m. Water could be added through the small funnel to compensate for evaporation.

It is important that the temperature of the air and of the solution be practically the same during the settling tests, for otherwise convection currents are set up which appreciably affect the settling rate. The heating unit under the beaker was constructed to have a minimum heat capacity, so that when it was cut off just before starting the settling test it cooled quickly and did not cause convection currents. After the causticizing reaction had been completed, the propeller was raised above the solution level and settling tests were made directly in the beaker.

The soda ash used was carefully dried and analyses showed it to contain 98.9 per cent Na_2CO_3. In most of the tests 200 grams of sodium carbonate and 1300 c.c. of water were used. After causticizing, the solution was approximately 15° Bé. (at 20° C.) in all cases, since evaporation was compensated for by small additions of water during the test.

In the first tests 118.5 grams of lime, corresponding to 3 per cent excess over that theoretically required to convert the soda ash completely to caustic soda, were slaked in 500 c.c. of water initially at 85° C. and stirred for 15 minutes, after which the soda ash, dissolved in 800 c.c. of water, was added and stirring was continued for 30 minutes longer. The average settling rate of the calcium carbonate in three tests under these conditions was 0.16 foot (0.049 meter) per hour. Although this settling rate is very low, even lower rates have been observed in some causticizing plants.

Small Amount of Water for Slaking.—Previous investigators have shown that the amount of water used in slaking the lime is important, so experiments were made to see whether the settling rate could be increased by changing the method of slaking the lime. Instead of slaking with 500 c.c. of water, only 80 c.c. were used and the dry hydrate was formed. This was then stirred with 550 c.c. of water for 10 minutes to be sure that hydration was completed, after which the soda ash was added in solution. The mixture was stirred for 30 minutes and at the end of this period the settling rate was found to be 1.41 feet (0.43 meter) per hour or 8.8 times the rate found when the lime was slaked in a large excess of water.

To be certain that this very large increase was not due to some peculiar characteristic of the particular lime tested, two other limes were compared in the same way. In one case the settling rate increased from 0.28 to 1.48 feet (0.085 to 0.45 meter) per hour and in the other case from 0.19 to 4.06 feet (0.058 to 1.24 meters) per hour. The average settling rate for the three limes is increased nearly twelve times by reducing the water used in slaking.

Excess Lime.—With this evidence that other limes showed the same general behavior as the one originally chosen, experiments with the original lime were continued. Tests were made to determine the effect of excess lime on the settling rate. In each case the lime was slaked just before the test by slowly pouring over it 100 c.c. of hot water. After the hydrate thus formed had cooled, it was added to a solution of 200 grams of sodium carbonate in 1350 c.c. of water at 85° C. and the mixture was agitated for 30 minutes, the temperature being maintained at 85° C. Before determining the settling rate in the last test, caustic liquor was added to reduce the ratio of solids to liquid to that in the test with 115 grams of lime. Unless the ratio of liquid to solid is kept uniform the settling rates cannot be fairly compared. The data are given in Table I.

Table I—Effect of Excess Lime

CaO Grams	Per cent of Theoretical	Causticity Per cent	Settling Rate Ft./hr.	Settling Rate M./hr.
100	87	79.9	2.97	0.91
115	100	87.6	2.97	0.91
130	113	92.7	2.82	0.86
150	150	94.1	2.12	0.65

Within reasonable limits it is evident that an excess of lime has only a slight effect on the settling rate.

Temperature and Time of Agitation.—The effect of temperature and of the period of agitation was then studied. Portions of the standard lime weighing 125 grams were slaked with 100 c.c. of hot water and then added to solutions containing 200 grams of sodium carbonate in 1350 c.c. of water.

Table II—Effect of Temperature and Period of Agitation

Agitation	70° C.			85° C.			95° C.			100° C.		
	Causticity	Settling rate		Causticity	Settling rate		Causticity	Settling rate		Causticity	Settling rate	
Minutes	Per cent	Ft./hr.	M./hr.	Per cent	Ft./hr.	M./hr.	Per cent	Ft./hr.	M./hr.	Per cent	Ft./hr.	M./hr.
15	88.8	4.22	1.29	89.7	3.75	1.14	90.7	3.91	1.19	....	....	....
30	92.0	3.43	1.05	92.8	2.97	0.91	92.7	3.13	0.95	92.0	....	....
45	92.8	2.97	0.91	92.9	2.34	0.71	93.0	2.66	0.81	....	....	....
60	93.6	2.42	0.74	93.8	1.96	0.60	93.7	2.50	0.76	94.0	1.87	0.57
90	94.5	1.88	0.57	95.3	1.56	0.48	94.0	2.39	0.73	95.4	1.77	0.54
120	95.4	1.56	0.48	94.6	1.33	0.41	93.9	1.77	0.54	94.6	1.46	0.45
150	94.6	1.35	0.41	94.6	1.19	0.36	94.8	1.64	0.50	94.9	1.38	0.42
195	95.4	1.25	0.38	95.5	1.13	0.35	94.8	1.50	0.46	....	....	....

Agitation was continued at the temperatures shown. The data are given in Table II.

It is evident that the settling rate decreases as the agitation is continued, and it is also evident that temperatures about 85° C. are of little benefit. Under the conditions of hydration and agitation used in the tests the reaction is nearly at equilibrium at the end of an hour. The causticity figures were obtained by titrating a portion of the supernatant liquor, after the test, with normal hydrochloric acid using phenolphthalein and methyl orange.

"Causticity" has been calculated using the formula

$$\text{Per cent causticity} = \frac{100(2PP\text{-}MO)}{MO}$$

where MO is the number of cubic centimeters of hydrochloric acid required to make the solution neutral to methyl orange and PP is the number of cubic centimeters required to make the solution neutral to phenolphthalein. Per cent causticity in this case is equivalent to per cent conversion or to the percentage of the original sodium carbonate which has been changed to sodium hydroxide. Some writers have used "causticity" as equivalent to per cent caustic or equal to

$$\frac{100\ (NaOH)}{NaOH + Na_2CO_3}$$

This formula gives lower numerical values than the formula which was used in these tests.

Lime Slaked in Hydrator.—Instead of slaking the lime by pouring water over it, it was decided to duplicate more closely the industrial operation for preparing hydrated lime by using a small hydrator arranged by placing a one-quart metal can on revolving rolls. A small hole in the cover allowed steam to escape during the hydration. The lime was placed in the can, 45 to 50 c.c. of cold water was quickly added, the cover was then put on, and the can was placed on the rolls. The slaking reaction began almost immediately and was usually practically complete within 2 minutes. However, the can was allowed to rotate for 10 minutes before the hydrate was removed. All hydrated lime used in the later tests was prepared in this way.

Slow Addition of Soda Ash.—It was thought possible that gradual addition of the soda ash might decrease the rate of formation of the calcium carbonate with a consequent increase in the size of the calcium carbonate crystals and an increase in settling rate. To test this point, 125 grams of the standard lime was hydrated and added to 650 c.c. of water at 95° C. Two hundred grams of soda ash was dissolved in 700 c.c. of hot water and the solution was added to the lime suspension in a slow stream over a period of half an hour, the lime suspension being kept at approximately 100° C. during this period. Agitation was continued for an hour after all the soda ash solution had been added. At the end of this time the settling rate was found to be 1.19 feet (0.36 meter) per hour and the causticity was 92.5 per cent. Slow addition of sodium carbonate does not appear to be desirable, since the settling rate was lowered rather than increased when using this method.

Hydration with Caustic Soda.—Another test was made to determine the effect of hydrating the lime with caustic soda solution instead of with water. Standard lime weighing 125 grams was placed in the hydrator and 47 c.c. of a 14.8° Bé. caustic solution, prepared in one of the previous causticizing tests, was added for hydration. The lime was considerably longer in reaching a maximum temperature than in the usual tests when water was used. The hydrate was added to the hot soda solution and the mixture was stirred for 90 minutes. Tests made during this period gave the data shown in Table III.

Table III—Lime Hydrated With Caustic Liquor

Agitation	Causiticity	Settling Rate	
Minutes	Per cent	Ft./hr.	M./hr.
30	91.5	7.81	2.38
60	92.8	6.57	2.00
90	94.4	5.64	1.72

It is evident that this method of preparing the hydrate yields an extremely rapid settling carbonate after causticizing. As agitation is continued the settling rate decreases, as previously noted.

Varying Degree of Agitation.—To determine the effect of changing the degree of agitation, comparative tests were made with the propeller running at 180 and at 420 r.p.m. The lime was hydrated with water as usual and added to the soda ash solution, the temperature being held at 85° C. The data are given in Table IV.

Table IV—Effect of Varying the Degree of Agitation

Agitation	180 r.p.m.			420 r.p.m.		
	Causticity	Settling rate		Causticity	Settling rate	
Minutes	Per cent	Ft./hr.	M./hr.	Per cent	Ft./hr.	M./hr.
30	94.7	2.50	0.76	95.0	1.67	0.51
60	95.3	1.98	0.60	95.2	1.48	0.45
90	95.1	1.72	0.52	95.9	1.25	0.38
120	95.3	1.56	0.48	....	....	....

Increasing the degree of agitation decreases the settling rate of the carbonate produced, but increases the rate of the causticizing reaction.

Comparative tests were next made on eleven different limes. In each case an amount of lime equivalent to 105 per cent of the quantity theoretically required to convert all the sodium carbonate to sodium hydroxide was slaked in the hydrator with 45 to 50 c.c. of water and was then added to 1350 c.c. of soda ash solution containing 200 grams of sodium carbonate. The mixture was agitated for one hour at 95° C., the propeller running at 180 r.p.m. Settling and causticity tests were made after 30 minutes and again after one hour. The data are given in Table V.

Table V—Comparison of Different Limes

Lime No.	30 Minutes' Agitation			60 Minutes' Agitation		
	Causticity	Settling rate		Causticity	Settling rate	
	Per cent	Ft./hr.	M./hr.	Per cent	Ft./hr.	M./hr.
1	94.7	2.50	0.76	95.3	1.98	0.60
3	93.4	1.96	0.60	95.0	1.77	0.54
4	94.6	1.33	0.41	95.5	1.29	0.39
5	93.4	1.33	0.41	94.8	1.29	0.39
6	94.3	1.56	0.48	94.9	1.33	0.41
7	91.4	3.33	1.01	93.1	3.25	0.99
8	90.5	2.08	0.63	93.2	1.77	0.54
9	91.2	5.63	1.72	92.6	4.06	1.24
10	94.3	1.46	0.44	95.4	1.46	0.45
11	90.2	5.31	1.62	92.8	4.06	1.24

Although there is a considerable variation in the settling rate of the different limes, their behavior is more uniform than might be expected. It will be noted that, in general, higher causticities are obtained with the slower settling carbonates. This seems to be a general rule. It was also observed that the very rapidly settling carbonates had a tendency to leave some fine material in suspension, whereas the very slow settling carbonate, being very bulky, carried down all the fine material, leaving a practically crystal-clear solution to be overflowed or drawn off.

The fact that rapidly settling hydrates yield rapidly settling carbonates after causticizing makes it appear probable that in the causticizing reaction the calcium hydrate particles do not pass into solution to be re-precipitated from solution, but that the carbonate is formed at the surface of the hydrate particle and that a gradual replacement of hydrate by carbonate occurs by diffusion in the particle. It seems quite probable that such replacements are comparatively common in those reactions in which a slightly soluble material is converted to a less soluble material and that the phenomenon is of general interest. The writers have been unable to find that any careful study of the nature of reactions of this kind has been made and would like to suggest it as an interesting field for fundamental research.

To test this idea, several experiments were made with various substances. If barium hydrate crystals, $Ba(OH)_2.8H_2O$, are placed in a drop of sulphate solution and observed with the microscope, it can be seen that the chemical action is occurring only at the surface of the crystals and that the coating of barium sulfate gradually increases in thickness. Similarly, lead chloride crystals in an iodide solution or lead iodide crystals in a chromate solution show the reaction taking place at the surface of the crystals without destruction of the original particles. To confirm this idea that relative particle size may persist through the course of a chemical reaction, barium hydrate crystals were ground and screened until two 70-gram portions were obtained. One portion was composed of particles between 100 and 200 mesh and the second portion all passed the 200-mesh screen. Each portion was added to a solution containing 75 grams (equivalent to 5 per cent excess) $Na_2SO_4.10H_2O$ in 225 c.c. of water, and the mixture was agitated at room temperature on bottle rolls turning 92 r.p.m. After various intervals settling tests were made and 10-c.c. samples of the supernatant liquid were titrated with normal hydrochloric acid to a phenolphthalein end point. The data are given in Table VI.

Table VI

Time Interval	—100 + 200 Mesh				—200 Mesh			
	HCl	Conversion	Settling rate		HCl	Conversion	Settling rate	
Hours	Cc.	Pct.	Ft./hr.	M./hr.	Cc.	Pct.	Ft./hr.	M./hr.
0.5	6.6	44.6	20±	6.09	10.3	69.6	0.83	0.25
1.0	7.7	51.8	20±	6.09	10.6	71.7	0.83	0.25
7.75	10.2	67.6	20±	6.09	11.6	77.9	0.75	0.23
16.75	10.9	71.8	20±	6.09	12.1	80.9	0.63	0.19

The results show clearly that relative particle size does persist throughout this reaction. The coarser hydrate yielded much coarser aggregates of barium sulfate with a correspondingly rapid settling rate. On the other hand, the reaction was much slower and the supernatant liquor after the bulk of the material had settled was decidedly more turbid when the coarser hydrate was used. These results are very similar to the data obtained from causticizing.

It seems probable that similar conditions exist in a number of industrial processes and that we should be able to alter the physical characteristics of one of the factors in the reaction when the latter is used as a suspension rather than as a true solution. However, when the reaction is accompanied by a comparatively large change in the volume of the solids involved, it will probably cause disruption

of the aggregates as they are formed, and the rule will be found to hold only partially.

Summary

In the process of causticizing the nature of the final precipitate can be greatly modified and its settling rate can be changed at least fifty fold, by changing the method of slaking and causticizing. Under standard conditions high-calcium limes from widely different sources give quite comparable results.

The rate of reaction and the turbidity of the supernatant liquor are both changed by the same factors that influence settling rate, so that it is usually necessary to accept a compromise in which the three factors are all considered.

Before an intelligent estimate can be made of the size of chemical equipment required for a given causticizing plant, all the factors affecting the settling and reaction rate must be considered and fixed.

It has been shown that relative particle size may persist through the course of a chemical reaction between a solid and solution and that this may be of decided importance in determining the settling behavior of the final precipitate.

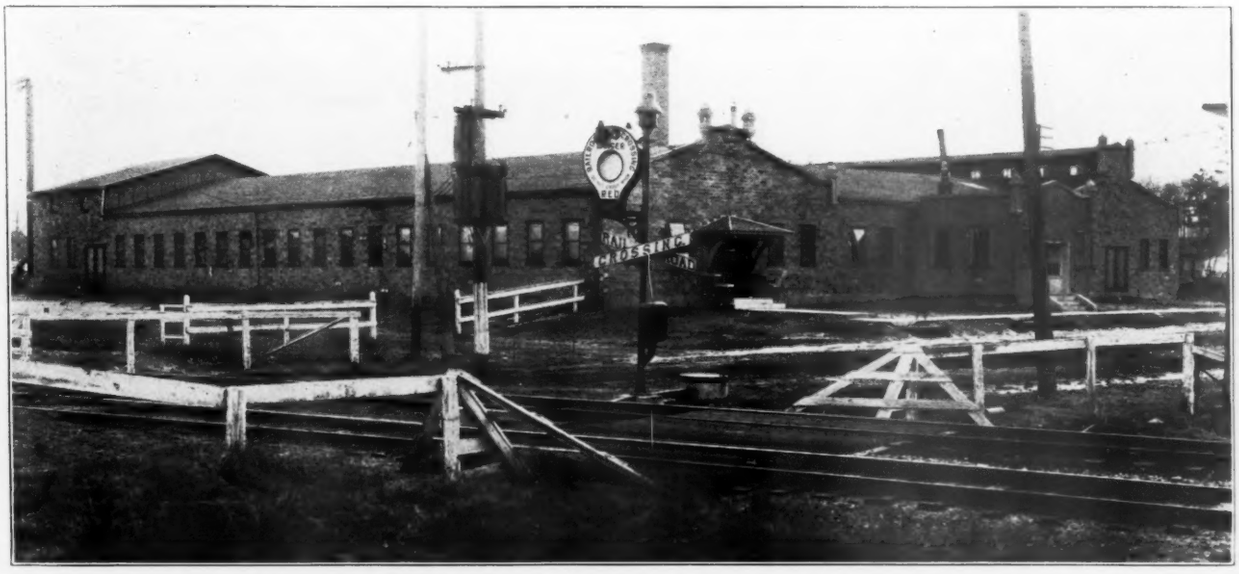
YAVAPAI ONYX MINING CORPORATION FAMED FOR MINING AND FINISHING ONYX

THE Yavapai Onyx Mining Corporation of Dyersville, Iowa, has had such a rapid growth that in the three years since its inception it has outgrown two plants and recently moved into its own large, completely equipped factory building. The new building is ideally located on a five acre tract of land owned by the company, with side tracks, unloading equipment, etc. This corporation has the distinction of being the only concern in the United States engaged exclusively in the mining and finishing of onyx. The rough stone is taken from the 320 acres of onyx deposits owned by the company in Yavapai County, Arizona, and shipped to the factory at Dyersville, Iowa, where it is finished for the trade.

The company has had a rather phenomenal growth. It was organized three years ago with Joseph A. Kelly as president. A small plant was leased in Dubuque, Iowa, and a few men employed. At the quarries in Arizona, when a carload of onyx was wanted a gang of miners from the nearby copper prospects was rounded up and the onyx taken out by mule and hand power. The Yavapai onyx is singularly colored and the demand for it has grown among the architects, interior decorators, etc.

Two or three years ago it is safe to say that not one person in fifty was familiar with onyx. The Yavapai Company has done much in the way of acquainting the public with this material through the manufacture of the onyx gear shift ball for the automobile and also small balls for radiator cap ornaments. Other items in the line of this corporation are counter and table tops, special design work for lamp and furniture and other manufacturers, church work such as onyx columns, fonts, candlesticks, etc. The stone is also employed in buildings for wainscoting, trim and other ornamental purposes.

As the American onyx became more generally



General Offices and Plant of Yavapai Onyx Mining Corporation, Dyersville, Iowa

Joseph A. Kelly, President Yavapai Onyx Mining Corp.

known the demand for it grew and a program of expansion was started that is still to be completed. Some equipment has been installed at the quarries and the entire output, which is at present about seven cars per month, is shipped to the finishing plant at Dyersville, which is modern in every respect and permits a production three times more than was possible formerly.

The onyx deposits in Arizona adjoin the little town of Mayer and are within several hundred feet of a branch line of the Santa Fe Railroad. The stone occurs in both ledge and boulder formation and is taken out by ordinary methods. In size, blocks weighing from two to twelve tons are now being shipped, although it is possible to secure blocks in larger sizes. The company recently completed the exterior trim on the building at 900 North Michigan Avenue, Chicago. The onyx used on this job is known as "Paisley Shawl" onyx and is unlike any other stone on the market. Both in color and veining, it resembles in marked degree an antique tapestry, and is so unique and handsome that it has attracted much attention and comment.

The Development of Welding

During the past few years weiding has developed to a great extent. Whereas a number of years ago many machine parts were made of cast iron or steel these are now being made of pressed steel and welded together thus forming a much lighter and stronger machine part.

Road Builders Move to Aid Agriculture

One of the most important moves ever taken in behalf of American Agriculture was made public recently in an announcement by the American Road Builders' Association to the effect that construction work on the nation's secondary highway system would receive immediate attention of the country's road builders. A national meeting of county road officials has been called for June 17th in Washington. At that time a new county organization will be formed for the purpose of immediately stimulating local road building.

The American secondary road system penetrates every farming community in the country, and includes more than 2,000,000 miles of highway but partially improved. The re-surfacing and reconstruction of a large portion of this system will be a work of the greatest importance to agriculture, particularly as it affects the marketing of products.

The necessity for organizing the more than 3,000 county road officials has long been recognized by the nation's road builders, it was stated by Charles M. Upham, Managing Director of the American Road Builders, who is directing the new movement. "The hundreds of important roads leading from farming communities to the local markets have not received the attention they warrant. The new organization of county officials will do much to standardize their highway construction methods, reduce road building costs, and give a new impetus to secondary road building."

Every county official in the United States has been invited to attend the meeting in June, and it is believed it will be one of the most important meetings of its kind ever held.

Purchasing Value of Dollar Jumps

Purchasing value of the dollar as measured by living costs for the American wage earner and other persons of moderate means, which includes the great majority of the population, today stands higher than it has for more than two years past, according to the National Industrial Conference Board, 247 Park Avenue, New York. The dollar is now worth, on the basis of present living costs, 61.1 cents as compared with the pre-war (1914) dollar. It was lowest in July, 1920, when it stood at 48.9.

The purchasing power of the dollar has been thus enhanced by the steady decline in average living costs throughout 1925 and 1926, which last April, however, were still 63.7 per cent higher than they had been in 1914, just before the war. But the average weekly earnings of industrial workers, owing to higher wage rates and more steady employment, at present are more than twice as high as they were in 1914, so that in spite of the higher living cost, the wage earner on the average draws weekly pay of about 34 per cent greater purchasing power than he did just before the war.

ROSS LOUTHAN OPERATES A DREDGING PLANT WITH LOW LABOR AND PRODUCTION COSTS

ROSS LOUTHAN, secretary, treasurer and general manager of the Northern Indiana Sand and Gravel Company, is known to many sand and gravel producers as a progressive business man. He has had years of experience in operating sand and gravel plants of different types but his new plant is better than any of the others that he has handled. The present plant located at Wolcottville, Indiana, embodies all the experience and ideas of Mr. Louthan. It is a low cost production plant with a good capacity. Seventy-five cars a day can be produced with a force of twelve men. The plant consists of an excellent all steel dredge, pumps, crushers, screens and conveyors. It is compact and efficiently laid out.

The Northern Indiana Sand and Gravel Company have a deposit of 106 acres about 22 acres of which are now being worked. The deposit runs 60 per cent sand and 40 per cent gravel. There is an average of 40 feet above water and 30 feet below. The bank is broken down by a stream of water controlled by a Universal nozzle. The dredge is a model all steel structure as the illustrations show. A 12 inch Morris pump handles the material through an Armco pipe line to the crushing and screening plant. This pump handles an 8 inch stone and anything over that size is ignored. A 4 inch Morris pump is used for priming. A two stage Worthington pump is used for pumping water for breaking down the bank. An Economy pump supplies the clean water for washing purposes.

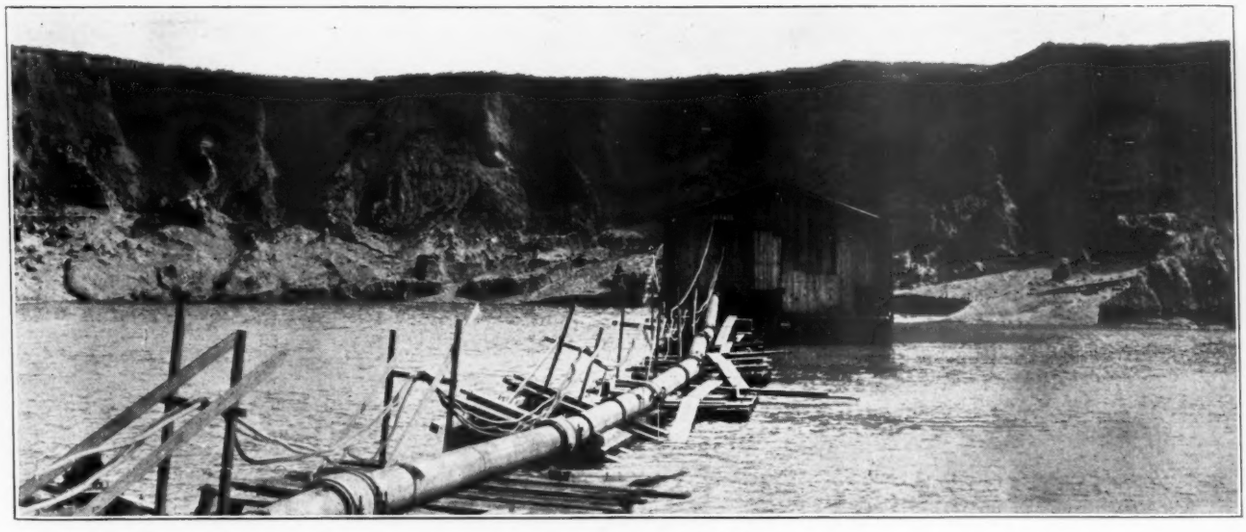
A Thomas two speed, three drum electric hoist operates a Diamond cutter. Both the hoist and cutter are shown in the illustrations. The 2½ inch material goes to a number 4 Austin gyratory crusher where it is crushed to 1½ inch gravel. The 1¾ and ¾ inch product is sent direct to gravel storage. A Rolman Manganese Steel Forge screen takes out the water and surplus sand from all the material, sand and gravel up to 8 inch stone. An Austin 15 foot 40 inch cylindrical screen separates the 2½ inch stone which passes to the Austin crusher and the 1¾ and ¾ inch gravel. The ¾ inch down material is sent to a Simplicity vibrating screen for fine classification.

The sand is graded by the flume method. All sand passes along a 100 foot flume with perforations in the bottom, falling out into open storage over a concrete tunnel by which it is reclaimed. This tunnel is 150 feet long and houses a 24 foot Manhattan belt conveyor operating over Weller idlers and pulleys. The belt is 450 feet long and conveys the material horizontally for 150 feet and then 75 feet up an incline to the loading bin. All water and waste is returned to the lake by gravity.

Railroad cars or trucks are loaded from the same bin. The Northern Indiana Sand and Gravel Company own and operate their own standard gauge engine for switching cars. In addition to the usual sizes of sand and gravel the company produce asphalt and plaster sand. Two grades of torpedo sand are produced. The dredge is all steel and was built by the American Steel Dredge Company. The balance of the plant is of good timber construction.

This plant is only in its third season. In 1926 it was electrified and brought up to its present state of efficiency. Last year 72 cars were loaded in one day with 12 men. The present layout is easily capable of producing 75 cars with 12 men. The present plant is operated with a force of 8 men.

The motors in the plant are all of ample capacity. The Thomas hoist has a 25 h.p., the 12 inch Morris



The Dredge and Pipe Line

Close Up View of the Bank Back of the Water Line

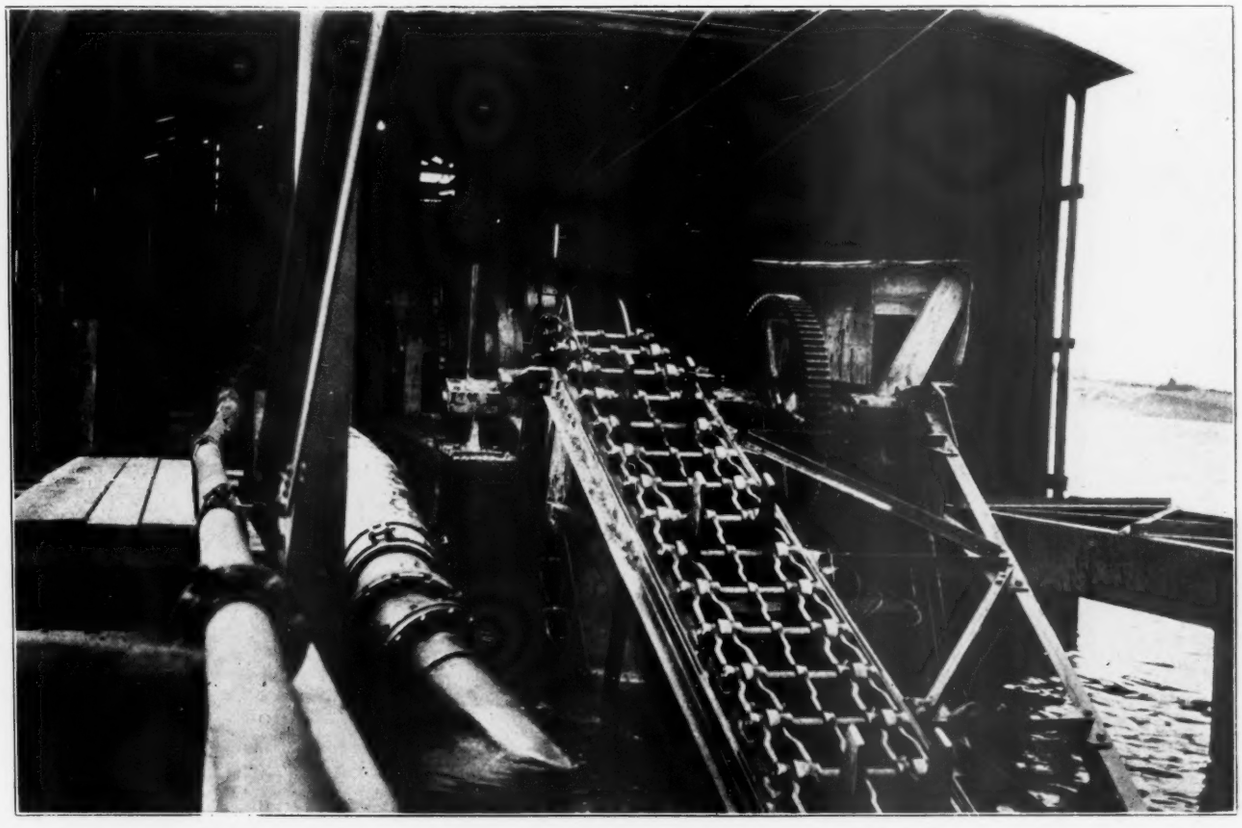
The Bank is Broken Up and Washed Down by the Stream of Water as Shown and Then Picked Up by the Dredge Pump

Close Up View of the Dredge. Note the Nozzle in the Right Front. The Hoist is in the Background

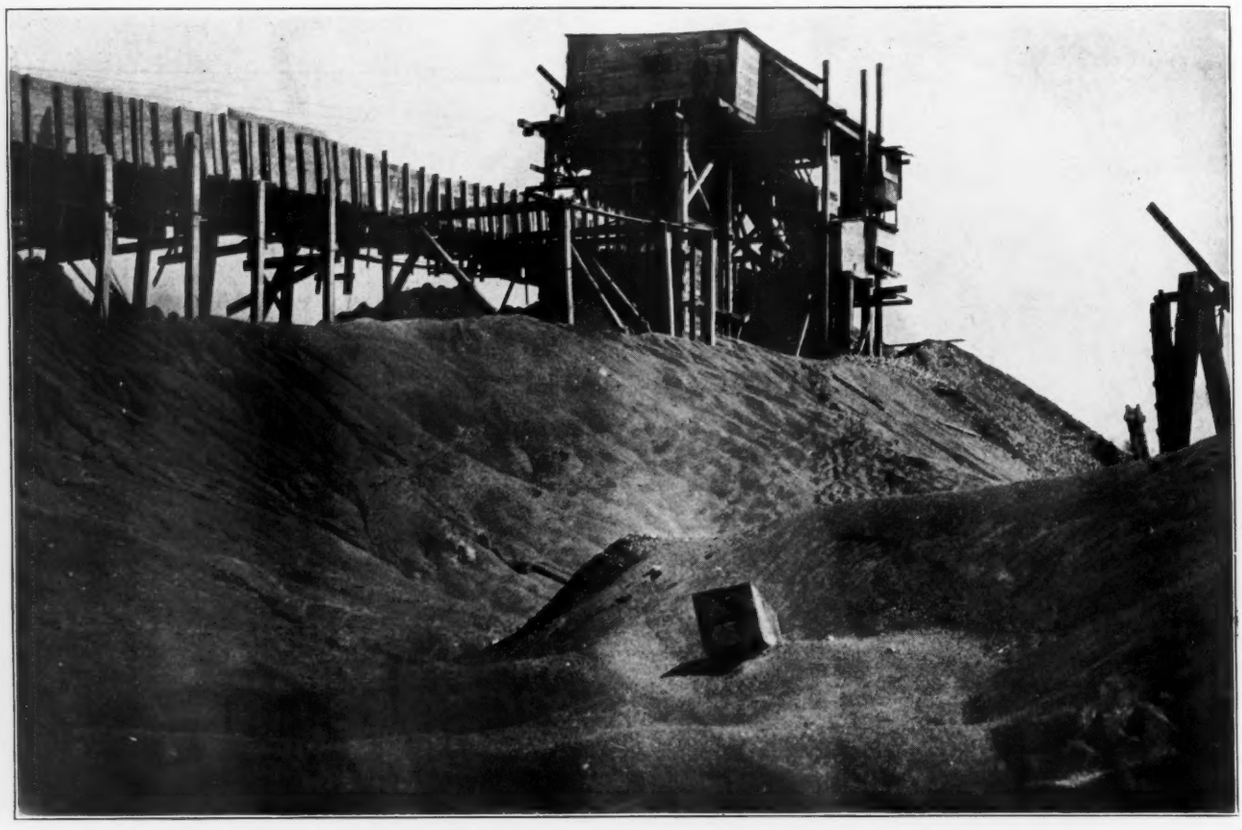
pump a 15 h.p., the Worthington pump a 40 h.p., the Austin cylindrical screen 25 h.p., the Austin crusher 25 h.p., the conveyor 40 h.p., and the Economy pump a 25 h.p. motor. All motors are General Electric manufacture.

The force of eight men are handled effectively. One man handles the boat. One man handles the crushing. One man looks after the screening. Two men handle the flume. One man handles the tunnel and there is one engineer and one foreman. Part of this crew load cars while the other part clean cars.

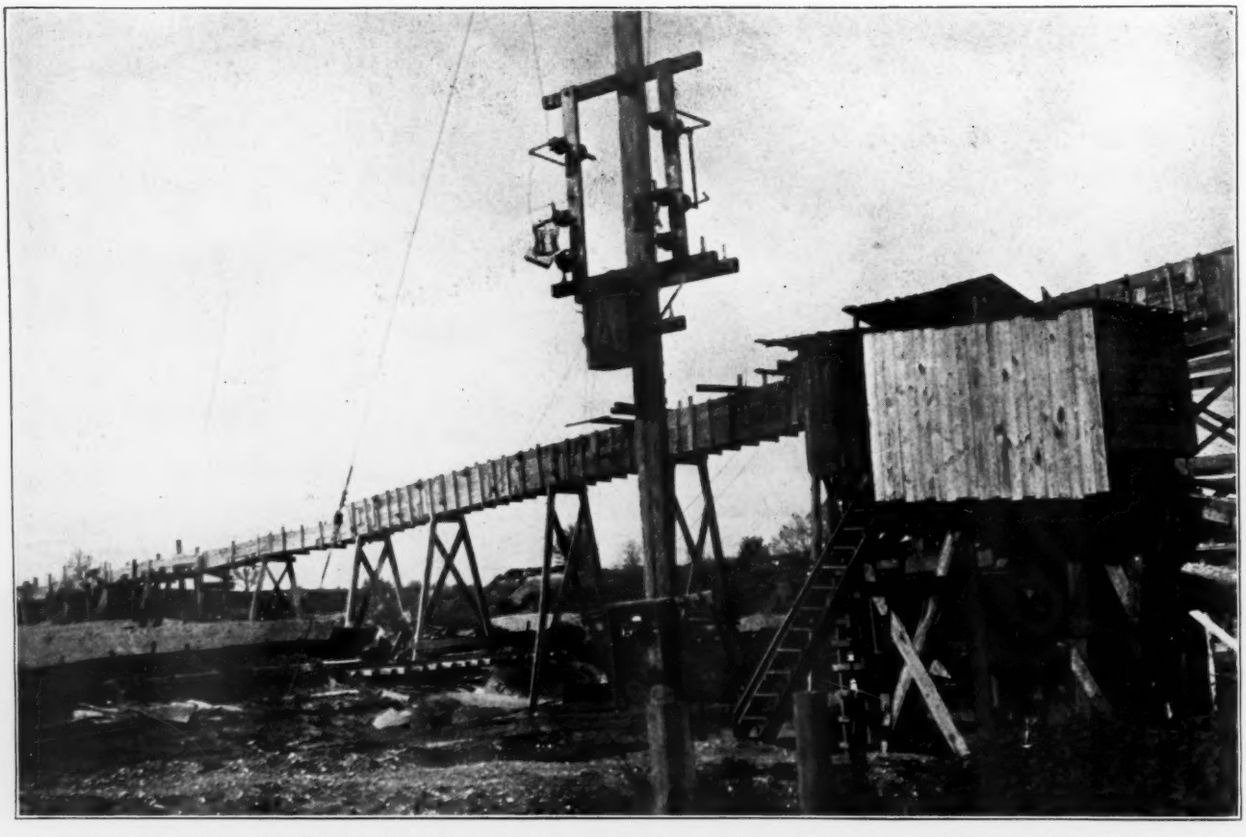
The Northern Indiana Sand and Gravel Company ship north 35 miles, west 13 miles, south 90 miles and east 90 miles. Shipments are made over both the Wabash and Pennsylvania railroads. An inter-



Close Up of the Agitator and Electric Hoist



The Sand Storage and Crushing and Screening Plant



Sand is Carried Along by This Wooden Flume and the Perforations in the Bottom of the Flume Permit the Sand to Fall

Another View of the Sand Storage and the Crushing and Screening Plant

esting bit of advertising done by the company comes to the attention of everyone entering either end of Wolcottville, when a huge billboard of welcome is seen and in the center is a large advertisement of the Northern Indiana Sand and Gravel Company.

The value of this welcome can be well understood when the visitor knows that it is genuine. Such a greeting makes the visit not only interesting but one to be remembered after the visitor has left the plant. The operation, though somewhat new as regards years, is yet modern in every particular and is being built with the idea of a permanent institution.

The plant represents an unusually small investment for the production secured. The average production is about 130 yards per hour. The stor-

The Conveyor From the Tunnel to the Loading Bins

age and material handling system is ample and flexible. The officers of the company include F. W. Tielker, president; Marion W. Cooper, vice-president and Ross Louthan, secretary, treasurer and general manager.

Mixed Macadam Pavement in Canada

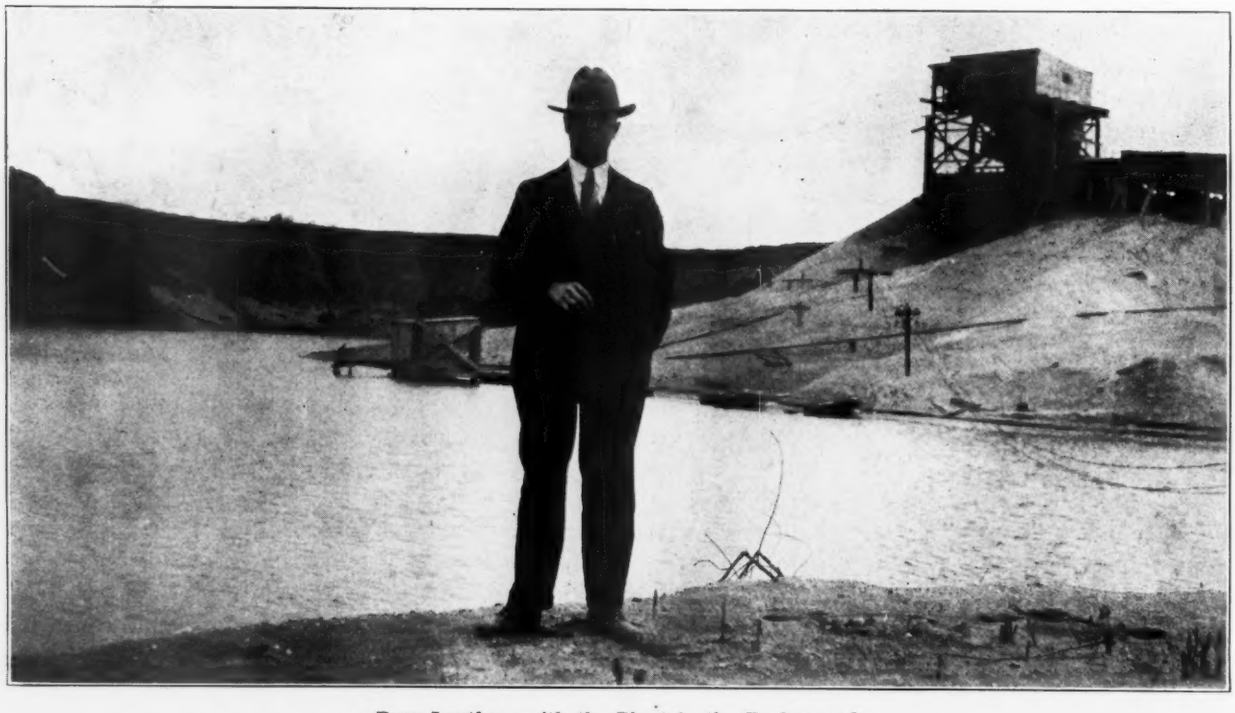
The department of Public Highways maintains at the University of Toronto a fully equipped highway laboratory. This laboratory is under the direction and guidance of an engineer who is constantly in touch with the district engineers throughout the province.

Last year the engineers on provincial work were asked to design a type of pavement that would meet all the requirements of a high-class pavement and at the same time carry the traffic with little or no interference. The development of mixed macadam followed as a result of a study of the construction of bituminous penetration surface. Bituminous penetration surface is and has been accepted as a superior type of pavement capable of carrying very heavy traffic with light maintenance for many years. It is built in Ontario three inches in thickness on concrete or macadam base. The greater part of the stone used in the construction of this pavement is of a size that will be retained on a 1¾ inch ring but will pass 3 inch ring openings. This stone after light rolling is treated with bitumen, chinked with ¾ inch stone and rolled until thoroughly consolidated, the surface later covered with ⅝ inch chips. Two gallons of bitumen per square yard are used in the construction of this type of road. Experience has proven that the voids in stone in the surface are not entirely filled.

The selection of the quarry or pit is particularly important. It goes without saying that only the best of local material should be considered. Crushed rock with its angular shapes gives key and bond that can hardly be obtained with gravel. If possible to obtain a quarry near a railway siding, a further advantage is gained in that asphaltic materials can be shipped in tank cars rather than drums, thereby saving several dollars per ton and many dollars per mile of road.

The stone after leaving the quarry face is passed through the crusher, the oversize being recrushed if necessary, until all stone will meet the specification. The material is then conveyed by elevator buckets and belt conveyor to the drier, the flow of material being continuous. The object of this is to keep the stone mix consistent. The stone after reaching the revolving drier is heated to 300 degrees Fahr. and thoroughly dried before reaching the hopper; it is then ready for mixing with the asphalt, which has been preheated in suitable melting kettles to a temperature equal to that of the stone. The materials, both stone and asphalt, are then properly proportioned by weighing and thoroughly mixed in a twin pug or batch mixer for a period of 45 seconds, after which the mixture is conveyed to the roadway.

Each course as it is spread is thoroughly rolled with a ten or twelve ton roller until absolutely consolidated. The top course receives, however, just before final consolidation, a coat of ⅜ inch chips, approximately 50 tons to the mile, but in any case sufficient to fill all voids that appear in the surface. These chips are applied while the surface is still warm and are thoroughly rolled in during final consolidation.



Ross Louthan, with the Plant in the Background

USE OF LIME IN WATER SOFTENING AND WATER PURIFICATION

By Charles P. Hoover*

LIME has been used for the last eighty-five years for reducing carbonate hardness from water and has been used during the past twenty-five years with sulfate of iron and other coagulants to effect clarification of turbid water.

The advantages of soft water and the economic results obtained by softening have been discussed often and sufficient evidence has been presented to prove that water softening more than pays its cost. Yet in spite of this, no great demand was made on municipalities for water softening until a few years ago. Many zeolite water-softening plants have been installed in private homes and industrial plants in recent years, allowing a great many people to enjoy the benefits of soft water and realize it is not necessary for communities to tolerate the annoyances from hard water. This may be the cause of the increased demand for soft water during the past five years, for during this time municipalities having a water supply with a hardness of 150 p. p. m. or more, and having occasion to build plants to improve their water supply, have included water softening.

The addition of lime to water not only softens it but, when added in sufficient quantity to produce residual or excess lime—caustic alkalinity—kills intestinal and pathogenic bacteria, rendering the water safe bacterially.

Sterilizing Scioto River Water With Lime.—Fifty-three one-gallon samples of river water were inoculated with 25 cc. of crude sewage, introducing from 3000 to 8000 colon bacilli per cubic centimeter and an average of 46,000 total numbers of bacteria. The samples so treated were vigorously shaken at 30-minute intervals for 5 hours and at the end of this period the total numbers of bacteria were determined and quantitative lactose bile presumptive tests for colon bacilli were made. The samples were then allowed to stand for 19 hours and a second bacterial analysis was made. After this test was finished, the samples were vigorously shaken and a third analysis was made. Over one thousand bacterial tests were made on these samples and the summary of the results is shown in Table I.

The results indicate that the lime has a selective action; intestinal bacteria are destroyed, but the percentage reduction of total numbers of bacteria is not so high. Intestinal bacteria are killed and not simply removed by the precipitated carbonate, because the numbers found were no higher in the samples that were shaken than they were in the supernatant samples.

Sterilizing Sewage Effluents With Lime.—Effluents from the sewage disposal plant at the Ohio Girls' Industrial School at Delaware, Ohio, were treated with lime. This sewage plant comprises septic tank treatment, sprinkling filters, and slow sand filtration. Samples were treated with 8.5, 9.3 and 11 grains of lime per gallon. Eleven grains of lime proved just enough to neutralize the temporary hardness and leave no excess lime. Table II shows the bacterial analysis before and after the lime treatment.

The results of these experiments, as well as the daily results of operation during the past nineteen years at the Columbus, Ohio, Water Softening and Purification Works, indicate that to insure quick sterilization of water with lime treatment the water must be treated with enough lime to produce a slight caustic alkalinity. However, with long reaction periods (24 to 72 hours) water treated with lime in sufficient quantities to soften it completely will be satisfactorily sterilized.

Caustic alkalinity is measured by titrating the softened water with standard acid, using first phenolphthalein as an indicator, followed by methyl orange. Many chemists believe that when phenolphthalein turns lime-softened water red, caustic alkalinity is indicated. This is not true. When twice the alkalinity to phenolphthalein is more than the methyl orange alkalinity, the difference between this doubled-up figure and the latter represents caustic alkalinity.

The lime softening process also increases the efficiency of sedimentation because better coagulation is effected. It is true that the use of lime with a coagulant, added in just sufficient quantities to effect clarification, has not been entirely successful because it is not applicable to all waters, and in some cases it may even do harm by increasing the pH value of the water sufficiently to prevent maximum precipitation of the coagulant. However, complete precipitation of coagulants added to the water is obtained if the water is treated with enough lime to give it causticity. Furthermore, almost all hard waters contain magnesium salts and lime reacts with them to form magnesium hydroxide, a bulky gelatinous precipitate which coagulates the suspended clay particles or mud as readily as the precipitates formed by sulfates of alumina or iron. Some waters also contain iron, which is very objectionable to the consumer because of its staining properties to plumbing fixtures and clothes and because it stops up water lines and meters. If the water is softened with lime, however, the presence of iron is an advantage, because, like magnesium, it

*Presented before the Symposium on Lime, Richmond, Va., April 13, 1927.

Table I—Bacterial Tests on Scioto River Water

Sample No.	Lime Added	Alkalinity					Average Colon Bacilli Per Cc.		
		To erythrosine	To phenol-phthalein	Bicarbonate	Normal carbonate	Caustic (excess lime)	5 Hours' Contact	24 Hours' Contact	
							Sample shaken	Supernatant solution	Sample shaken
	Grains/gal.	P. p. m.	P. p. m.	P.p. m.	P. p. m.	P. p. m.			
1 to 12	0.0	170	0	170	0	0	3000	1200	8000
12 to 27	6.0	54	17	20	34	0	300	300	400
27 to 34	7.0	44	24	0	40	4	10	2	0
34 to 39	8.5	48	31	0	34	14	2	0	0
39 to 53	10.0	77	64	0	26	51	0	0	0

is converted to a flocculent jelly-like precipitate, has coagulative properties, and is easily settled or filtered out and thus removed from the water.

At the Columbus plant the amount of precipitate formed by the softening reactions is about twenty times as great as could be obtained by ordinary coagulation processes. This large, bulky precipitate entangles fine particles of suspended matter, bacteria, and other impurities present in the water and settles very rapidly. A properly softened water should, at the time it is ready to leave the settling basin, have a bright greenish appearance and a turbidity not to exceed 1 or 2 p. p. m. One should be able to see an object immersed in it to a depth of at least 5 feet.

Table II—Bacterial Analysis of Sewage from Girls' Industrial School before and after Lime Treatment

(Gas production in lactose bile)

Period of Contact Hours	Sewage Tested Cc.	Raw Sewage	After Addition of Lime 8.5 gr./gal.	9.3gr./gal.	11.0 gr./gal.
5	10	+	+	+	+
	1	+	+	+	+
	0.1	+	+	+	+
	0.02	+	+	+	+
24	10	+	+	+	+
	1	+	+	+	0
	0.1	+	0	0	0
	0.02	+	0	0	0
48	10	+	+	+	0
	1	+	+	+	0
	0.1	+	0	0	0
	0.02	+	0	0	0
72	10	+	0	0	0
	1	+	0	0	0
	0.1	+	0	0	0
	0.02	0	0	0	0

Besides being low in turbidity, lime-softened water will be low in color and organic matter, these having been absorbed by the precipitates formed, and in addition objectionable gases such as carbon dioxide and hydrogen sulfide will be neutralized. Daily tests for the past eighteen years at the Columbus, Ohio, water-softening plant show an average reduction of coloring matter by the combined use of lime and alum from 25 to 4 p. p. m. Table III shows the reduction in color and organic matter in Scioto River water by alum treatment alone and by alum plus lime.

Table III.—Effect of Alum and Alum-Plus-Lime Treatment on Scioto River Water.

	Raw River Water	Treated with 1 Grain Per Gallon Alum	Treated with1 Grain Per Gallon Alum and Following Number of Grains per Gallon Lime: 10	11	12
Turbidity	80	0	0	0	0
Color	23	12	3	3	3
Total nitrogen	0.88	1.22	0.56	0.52	0.50
Albumen in ammonia as nitrogen	0.29	0.24	0.15	0.17	0.21
Free ammonia as nitrogen	0.07	0.08	0.07	0.09	0.12
Oxygen consumed	5.8	5.2	2.1	2.0	1.9
Total alkilinity, p.p.m.	144	142	48	50	60
Phenolphthalein alkalinity, p.p.m.	0	0	26	37	45
Caustic alkalinity, p.p.m.	0	0	4	24	30

The riddance of bacteria, turbidity, iron, color, organic matter, and objectionable gases from the water by lime treatment will lessen the cost of filtration if the water is to be filtered before being pumped to the consumers. The filtration load is so lightened that filter runs will be greatly lengthened or filtration areas may be reduced, thus cutting down first cost investment. The load applied to the filters should be so light that filter runs should be lengthened to at least 48 hours between washings. At the Columbus plant filters have on special occasions been run continuously for 6 days between washings.

The two principal limitations encountered in water softening have been: (1) In the early days of the art, lime-softened water was not stable because it was supersaturated with normal carbonates of calcium and magnesium, and distribution systems carrying the water, as well as meters and hot-water systems, would become incrusted with deposits of these carbonates. Serious trouble was encountered with the stoppage of hot-water pipes in hotels and public buildings on account of deposits formed therein because the water in these buildings is usually heated to a temperature higher than the average. (2) Limited results could be obtained in reduction of hardness on account of the formation of soluble complex basic carbonates of magnesium. These soluble salts cause the alkalinity of the softened water to be high, especially when soda ash is used along with the lime to reduce non-carbonate hardness.

A lime-softened water may now be cheaply and satisfactorily stabilized by recarbonizing it with carbon dioxide gas produced by burning coke, pulverized coal, oil or gas in a suitable furnace. After scrubbing and drying, the carbon dioxide gas is diffused into the water through small openings in a grid system located ahead of the filters. The carbon dioxide converts the normal carbonates, which are only slightly soluble, to bicarbonates, which are highly soluble and will therefore not be easily precipitated from the water. Enough carbon dioxide should be added so that the carbonated water will show just a faint trace of color when phenolphthalein is added to it.

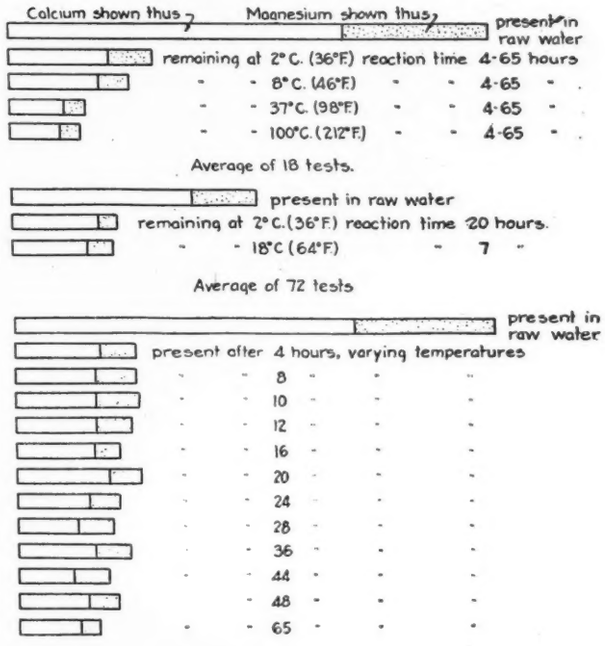
The limitations in the reduction of hardness have been largely overcome in the treatment of water for industrial purposes by (1) the hot process, (2) excess lime treatment, (3) split treatment, (4) ex-

cess lime followed by carbonation, (5) the use of compounds of alumina, and (6) the substitution of zeolite for soda ash to remove non-carbonate hardness.

Hot Process.—Temperature is one of the most important factors in lime water softening and at higher temperatures less calcium and magnesium remain in solution than at lower temperatures. During the winter months, well water at a temperature between 55 and 60 degrees Fahr. is much easier to soften than surface waters having a temperature around 32 degrees Fahr. The effect of temperature on water softening is shown in Table IV.

Table IV.

EFFECTS OF TEMPERATURE ON WATER SOFTENING
EXPERIMENT REACTIONS.
ALL SAMPLES TREATED WITH THE SAME AMOUNTS
OF LIME, SODA-ASH AND ALUM.
Average of 72 tests.



Excess Lime Treatment.—This consists in overtreating the water with lime—usually 2 or 3 grains excess lime per gallon are sufficient to precipitate the magnesium almost completely—then neutralizing the excess lime with soda ash, converting all the causticity to sodium causticity. The soda ash required is that necessary to combine with the non-carbonate hardness of the water and excess lime.

The results of analyses of samples of raw and softened water from two sources are given in Table V. These results show that by excess treatment it is possible to reduce hardness from 579 to 1080 p. p. m. to less than 30 p. p. m.

Split Treatment.—It is not good practice to pump highly caustic water to the consumers, and in order to reduce the hardness to as low a figure as possible in municipal water softening, split treatment should be used—that is, treating as large a portion of the hard water as possible to get maximum reduction of hardness and then neutralizing the excess sodium hydroxide by raw water. The proper proportion may be ascertained only by knowing the analysis of the water to be softened. Table VI shows what may be accomplished by split treatment.

Table V—Effects of Overtreatment on Softened Water

	Raw Water P. p. m.	Softened Water P. p. m.
Buckeye Steel Casting Co., Columbus, Ohio		
Total alkalinity	337	92
Phenolphthalein alkalinity	0	70
Caustic alkalinity	0	48
Calcium	161	6
Magnesium	43	3
Total hardness	579	27
Total hardness (grains per gallon)	34	Less than 2
Chicago, Milwaukee, and St. Paul Railway Co., Scotland, S. D.		
Calcium	225	7
Magnesium	126	2
Total hardness	1080	26
Total hardness (grains per gallon)	63	Less than 2

The split treatment reduces the hardness of a given quantity of raw water with a given quantity of chemicals more than the same quantity of chemicals will, when added in the usual way, but it is not so effective in reducing hardness as overtreatment.

Excess Lime Followed by Carbonation.—Water may be treated with excess lime in order to precipitate the magnesium salts and the excess calcium hydroxide then converted to insoluble calcium carbonate by carbonation and filtration.

Addition of Aluminum Compounds.—The addition of aluminum compounds, it is believed, converts soluble magnesium salts to insoluble magnesium aluminates, thus making it possible to remove them by settling or filtration.

Table VI—Effect of Split Treatment

Receiving All Chemicals Per cent	Raw Water Per cent	Hardness P. p. m.
	Series 1	
0	100	333
25	75	79
50	50	79
75	25	100
90	10	156
	Series 2	
0	100	305
25	75	96
100	0	133
	Series 3	
0	100	329
25	75	126
50	50	114
75	25	99
100	0	145

Water-softening bottle experiments are being run at the Columbus plant by treating 1-gallon samples of Scioto River water with lime, soda ash, and sulfate of alumina; with lime, soda ash, and sodium aluminate. In one series of experiments liquid sodium aluminate is used and in the other series a commercial compound of powdered sodium aluminate is used. As these experiments have just been started and are still under way, the tables and comments should be considered as preliminary. The samples were treated as shown in Table VII. The work was done by W. A. Kramer.

Table VII—Reduction of Hardness by Compounds of Aluminum (Laboratory Tests)

Chemicals			Hardness					
		Added		Alkalinity				
Lime	Soda ash	Alum-inum sulfate	Total	Phenol-phthalein	Caus-tic	Non-carbonate P.p.m.	Total P.p.m.	Magne-sium P.p.m.
Grains per gallon			P.p.m.	P.p.m.	P.p.m.	111	289	
0	0	0	178	0	0	43	102	27
14	5	0	50	39	19	46	98	...
14	6	1	52	35	18	38	85	...
14	7	2	47	25	3	26	68	...
14	8	3	42	17	0	9	51	...
14	9	4	42	13	0	—5	34	...
14	10	5	39	17	0			...

It was endeavored to reproduce the results obtained in bottle experiments on a large scale. The entire plant at Columbus, treating 31.7 million gallons per day, was operated for 3 days, using 5 grains of aluminum sulfate per gallon and enough soda ash and lime to reduce the hardness to the lowest possible figure. The character of the raw water treated and the results obtained on the last day of the test are shown in Table VIII.

Table VIII—Large-Scale Experiments with Aluminum Compound

Analysis of River Water	P. p. m.	Treatment	Grains per gallon
Total alkalinity	189		
Non-carbonate hardness	129	Lime	14.5
Total hardness	318	Soda ash	10.0
Magnesium	27	Sulfate of alumina	5.0

Results of Analysis of Softened Filtered Water

(Figures in parts per million)

Hour	12	2	4	6	8	10	12	2	4	6	8	10	Av.
Total alkalinity	46	47	47	47	45	46	44	49	48	59	59	59	50
Phenolphthalein alkalinity	29	30	30	32	28	28	28	28	28	29	32	29	29
Caustic alkalinity	12	13	13	17	11	10	12	7	8	0	5	0	8
Non-carbonate hardness	8	5	3	3	11	4	8	9	10	−1	−3	−3	5
Total hardness	54	52	50	50	56	50	52	58	58	58	56	56	55

The results in Table VIII indicate that the addition of an aluminum compound such as sulfate of alumina (3 to 5 grains) along with the lime and soda ash makes it possible at the Columbus plant to satisfactorily soften the hard water from the Scioto River to a hardness of between 35 to 50 p. p. m. without resorting to excess treatment with lime and soda ash. Without the use of aluminum compounds the limit seems to be somewhere between 80 and 100 p. p. m.

Substitution of Zeolites for Soda Ash to Remove Non-Carbonate Hardness.—It has already been mentioned that the addition of soda ash to remove the non-carbonate hardness is conducive to the formation of soluble hardness salts. We now know that it is not necessary and in many cases not advisable to use soda ash to remove permanent or non-carbonate hardness from water, because in communities where salt may be obtained at a fair cost it is cheaper to remove non-carbonate hardness by means of the zeolite process than by means of soda ash.

The operation of a lime-softening plant followed by zeolite treatment is about as follows: The water is first treated with sufficient lime to reduce the temporary or carbonate hardness to the lowest possible figure; then, after settling, it is carbonated with carbon dioxide to convert the normal carbonates to bicarbonates, thus preventing the deposition of normal carbonates on the zeolite sand and also preventing the formation of normal sodium carbonate in the softened water. The presence of sodium bicarbonate in the zeolite-softened water makes it possible to mix it with water containing non-carbonate hardness and not get a precipitation or an after-reaction. After settling and carbonation, the lime-softened water flows to the filters, and if desirable to reduce the hardness of the water to zero, all the water is passed through zeolite filters. If it is desirable to leave some residual hardness in the water then of course it is only necessary to filter a portion of the water through zeolite filters.

At the Columbus plant it is believed that it will be possible to reduce the hardness of the water from 300 p. p. m. to 160 p. p. m. by lime treatment alone, and that, in order to produce a softened water with a total hardness of, say, 80 p. p. m., it will be necessary to filter only half of it through zeolite filters, reducing the hardness of this portion to zero, and then mixing it with the other portion having a hardness of 160 p. p. m. The resultant product will have a hardness of 80 p. p. m. and no after-reactions are expected because the residual sodium salts in the zeolite softened water are present as bicarbonates.

Two modern applications of lime treatment have recently been described by Waring:

Experience at Youngstown, Ohio.—Several years ago the City of Youngstown instituted the excess lime treatment for the badly polluted Mahoning River water used as a source of supply at that plant. That the treatment has been a success is demonstrated by the experience of the last few years. The raw water pollution load at Youngstown is probably the greatest of any water treatment plant in the country. The yearly average B. coli index exceeds 20,000 per 100 cc. and it is not possible to use chlorine at this plant because of interference by phenol-bearing wastes. The final effluent during the past year has not shown a single positive presumptive B. coli test in any of the five 10-cc. portions tested daily.

Experience at Ironton, Ohio.—Following the unsuccessful attempt at Ironton to relieve the bacterial load in the Ohio River at that point, a change of treatment was made beginning in December, 1925. The experience of Youngstown has been made use of at Ironton in the following schedule: The plant has double coagulation facilities; accordingly, lime was applied to a primary basin in an amount to produce causticity, therefore sterilizing the supply. Alum was applied at the secondary basin to coagulate the turbid Ohio River water. It was noted that considerable alum was required if the influent water to the filters was to be kept in a condition to prevent carbonate scale forming on the sand grains as a result of the excess lime used. In order to economize on alum, the pH value of the water is being reduced by the use of carbon dioxide gas applied at the mixing chamber of the secondary basin. A saving of more than two grains of alum per gallon seems to be promised and the water coming to the filters contains no monocarbonate alkalinity that would incrust filters or piping beyond the plant. By means of the practice above related it will be possible to produce excellent filtered water without the use of any chlorine; without increasing the cost of the water treatment over previous practice; and having as reserve processes, or fac-

tors of safety in the treatment, both the coagulation in the secondary basin and the rapid sand filtration.

Experience at Columbus, Ohio.—At the Columbus plant it is customary to omit the chlorine treatment during flood periods when the organic matter is high and the water has an unpleasant taste or odor, and to substitute the excess lime treatment, about 20 p. p. m. caustic alkalinity being carried in the filtered water. This amount of caustic alkalinity is not noticeable to the consumer.

Softening a Hard Well-Water Supply.—One city in Ohio is now building a water-softening plant to soften a hard well-water supply. The water contains much objectionable iron which will also be removed in the softening process. This plant will be unique in that the softened water will not be filtered, and no after-troubles from deposits in the distribution system are anticipated because it is expected that the softened settled water will be sparkling clear and it will be carbonated, thus eliminating the possibility of incrustation in the mains.

The softening chemicals will be agitated with the water for one hour and a settling period of 24 hours will be allowed, with a velocity through the settling basins of less than 7 feet per hour. On account of its low cost of construction, this type of plant, made available for municipal water softening on account of the successful development of recarbonation, should prove attractive to communities wanting to soften and improve the quality of their already clear but hard water.

New Economics of Business

Keen competition, a constantly declining price level, and capacity that can easily cause production to run ahead of consumption are three forces now attacking profits in various lines of manufacturing. Competition is not only keen between individual companies within the same industry, but also between entire industries. Manufacturers having a certain product in common are seeking as a group to win the consumers' favor over another group having common interest in another product. Installment selling has intensified this "new competition."

Declining price levels have increased the problems of the manufacturer caught between the upper millstone of consumer resistance to further rise in the cost of living, and the nether millstone of pressures to maintain current high wage levels, to meet the higher costs for materials, equipment and supplies (arising out of intense demand and threatened shortages) and to absorb the higher costs of doing business. "Hand-to-mouth" buying has thrown the costs of carrying heavy inventories onto the manufacturer.

Capacity beyond that required to satisfy the current date of consumption encourages effort to increase that rate, yet circumstances operating to cut the current rate of consumption would obviously render idle much of the capacity now operating. And there is therefore question as to whether effort to force consumption for the sake of taking up present slack will not seriously jeopardize the capacity now being utilized effectively.

A review of "Statistics of Income" by the U. S. Bureau of Internal Revenue for 1922-1925, inclusive, shows a steadily declining profit margin. With these conditions a matter of common discussion among business men, the time was never more favorable for the application of Simplified Practice and allied waste-elimination measures recommended by the Hoover Committee on "Waste in Industry."

Simplified Practice, or the elimination of unnecessary variety in sizes, dimensions, grades, specifications, "line-numbers," etc., of commonly used commodities, means smaller inventories, quicker turnover, lower costs of doing business, greater efficiency in production and distribution. All of these combine to yield to the consumer good quality and fair price; to the worker good wages and steady work; and to the manufacturer, volume business at fair profit. Those who have applied it to their businesses know these results as facts. Have you tested Simplified Practice?

Construction of Granite Block Pavements

A span covering nineteen centuries separates the narrow pavements of Pompeii, the oldest stone block pavements, still in existence, from the latest stone block pavements being laid in Manhattan. The art of stone paving has changed from the use of large irregular slabs to a neat rectangular granite block, which according to Manhattan specifications, must run between 6 to 10 inches long, 3½ to 4½ inches wide, and 4¾ to 5½ inches deep, and lay to an average ⅜ inch joint.

In a city like New York, where the loads are exceedingly heavy and the speed of the vehicles is fast and where the surface of the streets is occupied to such a great extent by manhole heads, a great deal of vibration is set up. If the joint filler in a granite block pavement is such as to transmit this vibration to the curbs and, in turn, through the sidewalks to the adjoining buildings, a great deal of injury is done to the value of the buildings on account of vibration.

It was found that the best results are obtained if the asphalt is maintained in the kettle on the street at a temperature between 325 and 400 degrees Fahr., which is determined by equipping the kettles with thermometers. The sand, all of which must pass a 10 mesh sieve and not less than 85 per cent pass a 20 mesh sieve, is heated to a temperature between 300 and 400 degrees Fahr., the filler being poured into the joints between these limits.

CONDITIONS AND EFFECTS OF ELECTRIC DRIVES AS COMPARED WITH OLDER METHODS

By R. H. Rogers,
Industrial Engineering Department, General Electric Company*

IT IS the purpose of this paper to outline some of the broader and perhaps less obvious effects of electricity in industry. The immediate physical effects following the adoption of electric drive, such as reduction of power requirements, elimination of shafting and belts, and the attainment of greater flexibility in the application of power, have been repeatedly and copiously brought to the attention of all concerned. There are several deeper and more far-reaching conditions and effects to the credit of electricity that have not received such generous attention.

Between 65 and 70 per cent of all the power used in American industries is electric and the growth of this type of power is far greater than the total growth of power in industry. It is significant that the newer plants in an old established industry are the most nearly 100 per cent electrified and that the newer industries, such as the automotive activities, are, and have been from the first, practically 100 per cent electrified.

Our industries, in 1927, will use approximately 50 billion kilowatt-hours of electric energy, two-thirds of which will be purchased from power companies and one-third generated in private industrial plants. We can neither foresee the time when all industrial power will be electric nor when all the electric power will be purchased from central station systems. Many industries are characterized by the presence of by-product heat or by-product fuel or by uses for process steam. These items, together with privately owned water power sites, will long continue the use of other than electric power as well as the operation of private electric plants.

There is a strong trend, in the presence of by-product heat, by-product fuel or private water power, to convert to electricity as the medium for getting the power to the work to be done. The same is true where low pressure process steam is required, as it is a quite general practice to utilize the exhaust or to bleed low pressure steam from the turbine of a turbine generator, the electrical output of which is used to drive machinery. Having thus outlined the place of electricity in modern industry, some of its broader effects may be noted.

The first effect is the retirement of industrial plants to large industrial centers. Early operations were established at water power sites or in parcels along a stream to utilize several small water powers. Certain classes of work using great amounts of power on products of low unit value were for long considered feasible only with direct water wheel drive. The advent of electric power has changed all that. The small water power sites have passed out of the industrial picture. They are now combined into fewer heads and are driving hydro-electric stations tied in with steam stations to form great stable systems. The various enterprises are now fewer and larger. They are located in advantageous centers and enjoy full power the year around. Many times it has happened that a half dozen or more industries along a stream have pooled their water power rights, rescued the power formerly lost between plants, organized a hydro-electric company, reclaimed all the power required for their own use and marketed an equal amount of surplus power. The tie-in with other systems has given stable power and the old power limit to their expansion has been removed so that they are free to grow how and where they please without having to consider getting power from the old water-wheel shaft to their manufacturing processes.

My second consideration regards the change in conditions for the personnel of industry. The little bleak, monotonous mill town is passing, and men and women find their employment in large towns and cities where they can live broader lives. Their churches, theaters, contacts with people otherwise employed and the conveniences and facilities at hand make for contentment and a negligible labor turnover.

From another standpoint electric power has revolutionized processes and made possible great concentration of power under the control of few workers. A man having the power of 10,000 men under his hand must be inspired and uplifted by his commanding position as compared to one who labors only with the power of his own hands. The President of the American Federation of Labor has said that electric power with all that it entails is the greatest single factor in the shortening of working hours for American industrial employees.

A third angle from which we might view this general subject is that of the release of space and capital for application to production. Under the older systems a considerable portion of plant space was given to the production of power, either in a centralized power house or more often in a number of scattered boiler and engine rooms, or water wheel housings. Purchased power particularly has made it possible to utilize practically every foot of plant for production, to say nothing of the bettered conditions for production which have been thoroughly covered in numerous publications.

Capital investments, overhead and operation costs are heavy items chargeable to power plant equipments, and worst of all they are usually ad-

*A paper presented to the A. S. M. E. at Erie, Pa., June 3, 1927.

ministered by those whose prime interests are in the manufacture of some product other than power. Purchased power has therefore made available for direct application to production millions of dollars that would otherwise be tied up in the more or less inefficient production and distribution of power.

Conservation of our natural resources, our fourth effect, is not the least valuable of the functions of electricity. It has made available vast water powers with consequent direct saving of coal and it has, by concentrating steam power production into gigantic stations, reduced the coal requirement per horsepower as much as fourfold. Furthermore, it has made available for power purposes much of that wealth of by-product heat and by-product fuel that has in past years entirely gone to waste.

For the fifth subdivision of the subject we may consider the high rate of production that now prevails through the agency of electric power. The ways in which production has been speeded up are so numerous and divergent that we can only dwell upon a few of the outstanding instances. The manufacture of paper is a good example because electric drive has pushed up production rates in all branches of the industry. Water wheel driven pocket type grinders for making wood pulp have given way to motor-driven magazine type grinders utilizing motors of 2,800 horsepower. They are most economically arranged and ton for ton require only one-seventh the labor formerly needed and the work is carried out on one-tenth the ground space.

The paper machines are limited by mechanical drive to speeds of 500 or 600 feet per minute and in widths to less than 200 inches. With individual electric drive the common speeds are now 1,000 feet per minute with 1,200 feet attained in some cases. Certain new machines are designed for an ultimate speed of 1,450 feet per minute and widths are now up to 270 inches or for a trimmed sheet 22 feet wide made at a speed of over fifteen miles per hour. With all this speed, reliability has been bettered and sheets seven hundred miles between breaks have been produced, while maintenance costs of the drive have dropped to one-fourth the figures that held for the older drives.

Woodworking in all its details has been speeded up. This effect is felt from logging and yarding clear through to the manufacture of the finest of wood products. Huge head saws tear through giant logs at unbelievable speeds under the urge of the relentless electric motor. At the other end of the scene tiny motors driving sanders, molders, tenoners and the like run at speeds unattainable by mechanical arrangements of gears or belts. Some run as high as 30,000 revolutions a minute with consequent rapid feeds and savings of rehandlings for grain directions so that production is speeded up to keep pace with these electrical times.

An abrupt change of thought brings us to the effects of welding by electric arc in manufacturing. The adoption for production purposes of this process, which only a short time ago was looked upon as a means for making repairs or as a "putting-on tool," has been so rapid and far reaching that the general public and even those more intimately connected with the metal world are as yet unaware of its scope.

Arc welding for thousands of products does away with patterns, castings together with casting losses, much of machining, and withal results in lighter, stronger and better construction. It reduces necessary stock of materials and parts, and greatly shortens the time from completion of design or receipt of order to the finished article. The electrical manufacturer has not been slow in taking liberal doses of his own medicine. Particularly is this true of General Electric, where the arc weld has made possible marked reductions in the space occupied, in the time required and in the developments and shop costs of many of our major products.

Electric heat, while old in theory, has only lately come into prominence as a feature in manufacturing. The growth of heating loads on central station systems is astounding and it is freely predicted that its possibilities equal those of electric power. Wherever it is used, the result is a speeding up of the process coupled with better and more uniform results and a reduction in maintenance costs.

The sixth and last phase to be considered here is that of production costs. Costs are naturally reduced if power is delivered more cheaply at the place where the useful work is done. With the exception of the aluminum and ice industries, the cost of power runs from one-half to six cents per dollar's worth of product. A change of 25 per cent either way in power cost would therefore affect total costs but little. The summation of the less tangible advantages of electric drive is of far greater importance and that is what has brought electric drive into undisputed leadership. The saving on capital charges and the release of space to other uses wherever electric power supersedes the older methods has been outlined in previous paragraphs. We will now review some of the other ways in which production costs are affected.

Mining calls for the use of the largest power shovels for stripping overburden. Electric power shovels, besides lowering the visible costs per cubic yard, show remarkable superiority from the maintenance standpoint. The largest steam power shovels require approximately $25,000 per year for maintenance, whereas the corresponding electric shovels are maintained for $5,000 per year. Little of that expense goes into the electrical features. The principal differences are in the steam plant upkeep and general repairs and replacements. Electric shovel drive, while more forceful than steam, has the faculty of minimizing shocks and strains so that with greater yardage the wear and tear is wonderfully reduced.

Mine hoists are among the most interesting power applications and developments have been carried to a point where no other form of power could possibly meet present day duty cycles. The result is reduced cost of production because, in addition to lessening the cost per ten foot of hoisting duty, fewer shafts are required and less additional expense is incurred as mines are deepened or output is increased.

Oil well drilling and pumping illustrate well the importance of what at first appear to be secondary considerations. While the power costs per foot drilled or per gallon pumped are primarily considered probably more, owners are influenced by the reduced costs attributable to greater continuity of service, lesser capital investment and the improved conditions as to fire and personal hazards.

Steel mills are among the greatest users of electric power and the newer the mill the more nearly will it be 100 per cent electric. Lowered production costs are obtained through being able, with electric power, to do things in ways and at rates that would otherwise be impossible. Concentration into great units reduces the labor cost even more than it reduces the power cost.

The large new paper mills, entirely electrified, using gigantic units, have cut production costs so that smaller old style mills are hard pressed or have given over their water power sites to hydroelectric stations. These results are not so largely credited to cheaper power as to reduced labor, reduced maintenance and more perfect continuity of manufacturing operations.

Examples without end could be cited to show the less conspicuous ways in which electric power reduces production costs but enough have been given to indicate that the more obvious characteristics are often of minor importance.

A summary of the effects of electric drive compared with older methods as noted in this paper, will serve to bring out more clearly the salient points.

1. Location and plant-plan freed from the old limitations as to source of power and its distribution.

2. Improved living conditions and a general uplift in personnel.

3. Release of capital and space for direct manufacturing operations.

4. Conservation of coal and oil by utilizing water power and by using fuel more effectively.

5. The speeding up of production makes more output possible per unit of space and per man-hour of labor.

6. Reduction of production costs results from various combinations of all the above, together with marked reductions in the cost of the power that is actually delivered to the work to be done.

Huge Roadbuilding Program for Persia

The Director General of Roads has submitted to the Persian Government a program for a system of highways totaling 17,021 kilometers or 10,576 miles to be built over a period of nine years at an estimated cost of 52,300,000 tomans (one toman is approximately equivalent to one dollar) ; or, with an allowance of 7,000,000 tomans for work already done, at a cost of 45,000,000 tomans.

This proposal, which now is being studied by the Government, does not include maintenance of existing roads, or of new roads when constructed. It is not possible to state accurately the sums that are now, or that in future may be needed for this purpose, but it is estimated that to keep existing roads in good condition would require 500,000 tomans per annum and that when the entire system has been completed the annual cost will be about 1,500,000 tomans.

While an expenditure on a road program of about $45,000,000 may appear staggering to a country that assuredly has spent no such sum for the same purpose in the course of the past half century, it would result, on the basis of a population of 10,000,000, in an annual per capita expenditure of only about $0.50 as compared with a reported per capita expenditure in a recent year in the United States of approximately $11. Even when allowance is made for the difference in the wealth of the two countries the proposed expenditure in Persia does not appear to be abnormally large.

Again, the proposed construction will give only one kilometer of road for every 94 square kilometers of area and for every 600 inhabitants, as compared with (reported figures) one kilometer of road for every 1.6 kilometers of area and for every 21 inhabitants in the United States. The proposed highways are divided into first class, second class, and third class roads. These classifications are made for Persia alone; they are not to be understood to be identical with first, second and third class roads in Europe or the United States.

Production Volume Increases

The total manufacturing production in the United States has increased about 65 per cent in volume from 1914 to 1925, or about three and one-half times as fast as the population, which has increased less than 18 per cent in the same period, according to a study just completed by the National Industrial Conference Board. The production of manufacturing industries per wage earner employed in 1925 was 35 per cent or more than a third greater than in 1914, volume of production having far outstripped the increase in the number of workers as well as population growth.

HOW STAMFORD LOCAL MATERIAL COMPANY HANDLES SOME OF ITS PROBLEMS

By W. P. Varian, President

WHEN the Stamford Local Material Company incorporated in August, 1925, with limited capital, but an abiding faith in the future of the sand, gravel and crushed stone business, it realized that its most immediate task was the building up of a reputation for integrity and faithful service, the establishment of confidence in its venture among local banking circles, and the plowing back of sufficient net earnings to secure modern equipment so vital to its normal growth and healthy expansion.

The Company, composed of Harold H. Mead of New Canaan, Connecticut, who was its former owner, and who has spent the major portion of his business career in the sand and gravel business; Lester R. Ferriss of Hartford, Treasurer of the Russell P. Tabor, Inc.; and William P. Varian of New Canaan, formerly in the stock brokerage and foreign and domestic bond business in New York City are the owners of over thirty acres of the finest gravel deposit in Fairfield County, situated in the village of Glenbrook, a suburb of the Township of Darien, and within ten minutes haulage of the centre of the City of Stamford, Connecticut.

The Company started its career with an old five ton Packard truck, which had rendered close on seven years of faithful service but had about lived its life; a fairly new five ton Mack; a one ton Ford dump truck; a 9½ D Acme Road Machinery Company crusher, and a Green drag-line scraper, which had originally been purchased with the fond hopes of increasing production and cutting operation costs. Through no fault of its own, but due largely to the high percentage of large cobbles and big boulders tightly wedged in the gravel deposit upon which even dynamite failed to make an impression,

View of the East Pit With Part of the Crew

the drag-line proved a losing proposition, and had to be disposed of at a sacrifice.

Like all normal boys, the Company's growth was accompanied by the usual growing pains, but despite heavy outlays for betterments and improvements, and thanks to faith in its future success on the part of their Stamford bank, the company was soon the owner of a new five ton Mack, and two new Ford one-ton gravity dump trucks, equipped with the shift and Rexall rear end, so essential to heavy duty in the soft gravel footing. With the acquisition of better equipment, and the logical improvement in service to its customers, the Company's business began to gradually expand, until it was soon possible to whittle off substantial chunks from the $14,500.00 mortgage with which it started its career. Incidentally this encumbrance is gradually approaching the vanishing point, due to a systematic adherence to a schedule of monthly payments derived from net profits, which has dropped the mortgage below the $5,000 mark in a little over a year and a half.

The Stamford Local Material Company has one big advantage over all of its competitors, and that is in its diversified list of materials produced, including sand, gravel and the various sizes and grades of native crushed stone, cobbles used in the construction of stone walls, building stone for foundations, large boulders for the construction of sea-walls, loam in almost unlimited quantity for gardens, lawns and green-houses, subsoil for fill secured in stripping operations in clearing the over-burden on the gravel banks, and dead sand used by the Connecticut State Highways Department in the manufacture of their asphalt. Beside this, it has built up an excellent market for road sand for oiling purposes, and road gravel with just the proper proportion of loamy content to secure the ideal bind, for the building and maintenance of gravel roads.

It has been discovered by local road contractors that the tailings, a two and one half inch broken stone secured from the end of the rotary screen, make a first class base-stone for penetration road jobs, while the pulverized stone, or stone-dust as it is commonly called, when mixed with the proper proportions of cement, make an excellent concrete, which seems to set up quicker and harder than when sand is employed in similar proportions. In addition to this, the stone-dust makes an ideal top-dressing for drive-ways, for unlike the clear broker stone, it does not scatter or show the slightest imprint of a wheel, after the first heavy rain, which causes it to pack down and harden until in a brief space of time, if subjected to constant automobile traffic, it becomes almost as smooth and firm as a concrete road. The proportions of fine broken stone in this mixture, ranging in size from a sixteenth to an eighth of an inch are so high, that they not only give an excellent bind, but come to the surface after a few showers, and lend a pleasing color tone to the drive, a light grey being the predominating color, although a close inspection of this native stone, which is almost as hard as trap-rock, discloses that a white, pink and blue figure in the color scheme, with a dash of micre to give it a sparkle, but not enough in evidence to affect cement work.

With the steady expansion of all branches of the business throughout the year of 1926, which saw a gross turn-over of over $50,000, and a satisfactory net, the next logical step was the purchase of a shovel. This forward step, it was felt, should be preceded by much serious thought. Just about

The Entire Force with the Crushing Plant in the Rear

this time, fate, in the form of a local real estate boom, stepped in and lent a helping hand, making lots along the road frontage. With this as a bracer, it possible to market over $5,000 worth of building the three partners paid a visit early this Spring to their local banker, and found that he was ready and willing to extend them the additional capital required to finance a good shovel. The problem then, and it was a real one, was what to buy. Looking at it from every angle, the company felt that a gasoline driven caterpillar, or crawler type of shovel, was the one best bet. With this conclusion, the trip was made to New York City, and a visit was paid to Hubbard-Floyd Company, Inc., Eastern representatives of the Northwest Shovel Company. Fortunately this concern had a machine on hand in their up-town yard, equipped with a one yard manganese steel bucket, a 24 foot box boom and a 17½ foot dipper stick, which looked as if it would just fill the bill for extensive gravel operations. Despite the fact that the partners had made the trip with the intention of only buying the half-yard machine, it did not take them long to close the deal for the larger and more expensive unit. Their sound judgment in this respect has been vindicated, for this new unit has fairly revolutionized their business, making it possible for the company to handle loam and gravel in lots of a thousand yards, pick up the surplus stone in the yard and load it on the trucks at considerably diminished cost, keep the stone crusher going at a maximum capacity, and at the same time grade off the road frontage for profitable real estate purposes. A fair idea can be obtained as to what this shovel has accomplished, by a glance at the gross sales for April of this year, a grand total of $8,152.00, against $5,000 for April, 1926. It would not be deemed good business to disclose to what extent it had improved the net profits, but suffice to say that the company now feels that it can begin to give serious thought to the purchase of a large new tailings crusher, with the necessary electric motor to drive in, and the erection of modern and suitable bins. Through good service, fair prices, and excellent materials, the demand has rapidly increased for the smaller grades of crushed stone, so that this next forward step is almost imperative.

Its two Macks can no longer satisfy the trade, so it is often necessary to hire from two to five extra trucks. As an excellent market has been built up both in New Canaan, a small village but boasting many large estates, and along the Connecticut shore from Greenwich to Bridgeport, the Company is also contemplating the purchase of a Reo heavy duty speed wagon, to insure prompt delivery to these various distant points. One new Ford one-ton dump truck will be immediately purchased, to be used for outside deliveries in small quantities, where speed is essential, the other two Fords being employed in the yard to move stone and gravel to the crusher and the belt conveyor outfit, a unit used for the manufacture of gravel. It consists of

Shovel at Work in the West Pit

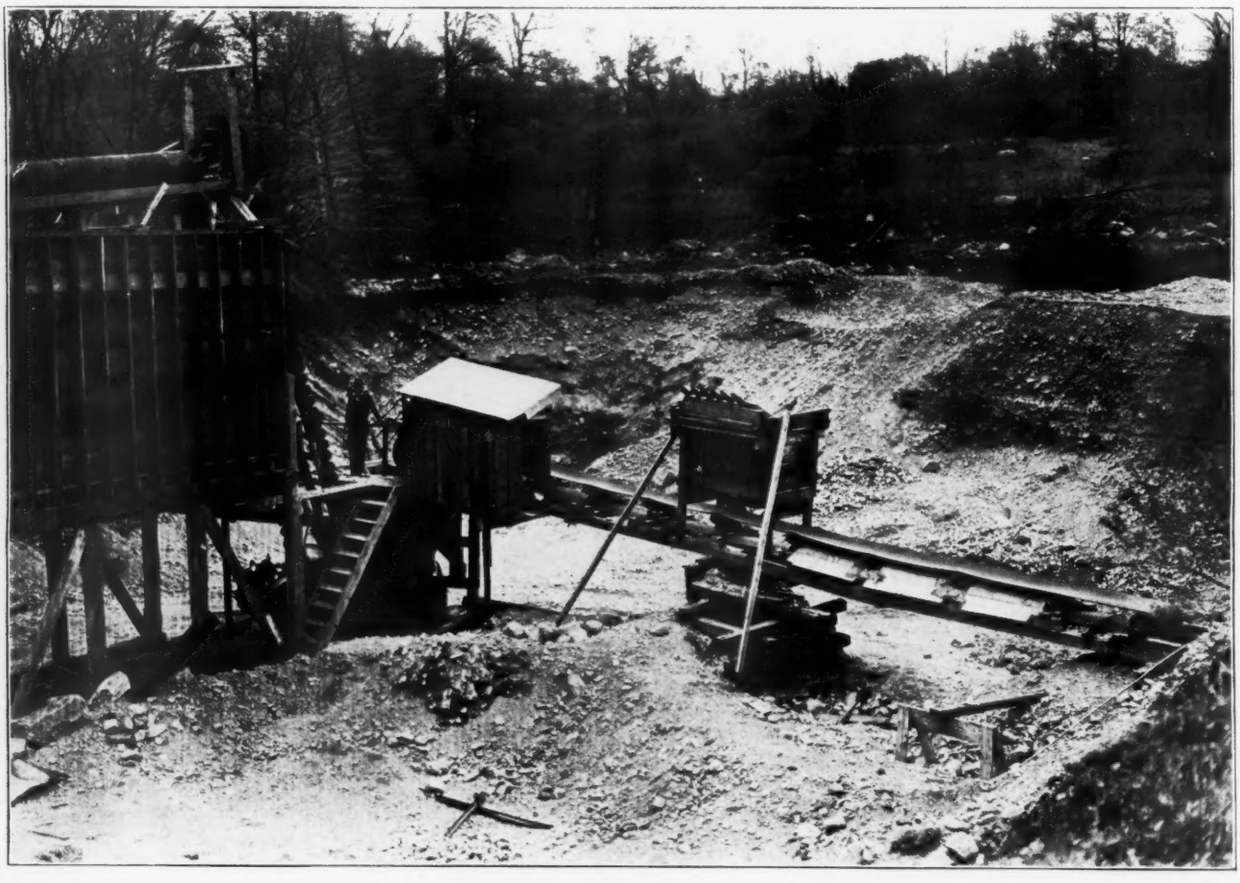
100 feet of 36 inch rubber belting, suitable to withstand the elements, driven by a 5 horse-power electric motor, fed by a large hopper equipped with grizzly bars so that no large cobbles can clog the flow of gravel when the gasolene shovel dumps in its load. The coarse gravel is then carried along the belt to another set of grizzly bars, so placed that the heavy stone slides down them into the awaiting Ford truck below, the gravel going into a chute and thence elevated in endless buckets electrically motor driven, to the rotary screen above, which sorts and distributes the gravel into the various bin compartments.

At such times when it is not convenient to employ the shovel to pick up and load the surplus materials on the ground, a Haiss loader is employed for this purpose, and proves a satisfactory substitute, although it is not as mobile and flexible as the shovel, and requires the services of two men, where only one is needed on the Northwest.

The company is now ready to branch out in the road construction business, and has contracted to put in several gravel roads both in Darien and New Canaan, the gasoline shovel having proven such a labor saver that it has released the services of from two to three men in the regular organization who can now be employed profitably in outside ventures. To facilitate the preparation of these large quantities of gravel, a large portable grizzly has been constructed, which can be picked up by the shovel and shifted from place to place along the face of the bank, the large stone which roll off the bars being more than sufficient to keep the stone crusher going at maximum capacity. Experiments have been made in the construction of an eight foot concrete fence post, pulverized stone and cement being the ingredients used, reenforced by two iron rods, which have proved both durable, serviceable and salable, and should general business slow down during the coming winter months, an effort will be made to organize this sideline along lines of quantity production.

The field is broad and the possibilities unlimited, and this new firm faces the future secure in the knowledge that they are dealers in a basic commodity for which the demand is constantly increasing. A continuation of their present policy of faithful service, coupled with the logical growth of this section of Connecticut in which they are located, is all that is necessary to insure their future success. Westchester County, N. Y., is spilling its overfow across the State line into Fairfield County, and these new land buyers and home seekers come well supplied with the coin of the realm, in most cases secured through the sale of their former homes at handsome profits.

Situated as it is, in the very center of an ideal residential section, the Stamford Local Material Company enjoys the unique distinction of being able to sell these pioneers the lot, dig the excavation, furnish the gravel for the concrete foundation and mix and pour the same if required.



Showing the Conveyor and Plant in the East Pit

BRIEF ANALYSIS OF FUNCTION OF STEAM ON DECOMPOSITION OF LIMESTONE

By E. E. Berger,
New Brunswick Station, U. S. Bureau of Mines*

CALCINATION of limestone is one of the earliest industries concerning which we have any record. The process was discovered accidentally and was carried out for some time before any attempt was made to control the reactions involved or to study the principles by which the process was governed. Recently considerable progress has been made in improving the methods used in the burning of lime, but there are still certain processes employed concerning which little fundamental knowledge is available, and consequently there can be no definite measure of their value.

The use of steam in lime-burning is an outstanding example of a process that is not clearly understood. Steam is used in the majority of lime plants, but other methods have also been advanced for promoting calcination and controlling combustion. The relative merits of the different processes are not known. The high cost of installation and maintenance of steam boilers, along with the indefinite knowledge concerning the real function of steam in the lime kiln, led the Nonmetallic Minerals Station of the Bureau of Mines to undertake an experimental study of the effect of the steam on the calcination of limestone. The primary purpose of this investigation was to determine whether steam actually did have any effect on the calcination process. If it was found to have such an effect the plan was to discover the reason for the peculiar action of steam so as to make the results more applicable to lime-kiln conditions.

The possibility of using steam to promote the calcination of limestone was considered as early as the latter part of the eighteenth century, but the results obtained by Herzfield are the only data generally available which give an actual comparison between the action of steam and air on the calcination.

In Herzfield's experiments limestone was completely calcined in 45 minutes when subjected to a current of steam at 790 degrees Cent. and only 43 per cent calcined when subjected to a current of air at the same temperature. These results have received wide publication and many lime operators have thus been led to believe that steam will in some way aid the calcination of limestone; consequently, it has been used extensively in the burning of lime. A careful study of the apparatus used in Herzfield's experiments will reveal, however, that even though the work was conducted with considerable care, the conditions of calcination were not under absolute control and consequently rather large errors were possible. This fact, together with the lack of any adequate explanation for the possible effect of steam on the calcination of limestone, made it imperative that further research be conducted on this subject before any definite theory could be formulated concerning the action of steam in a lime kiln.

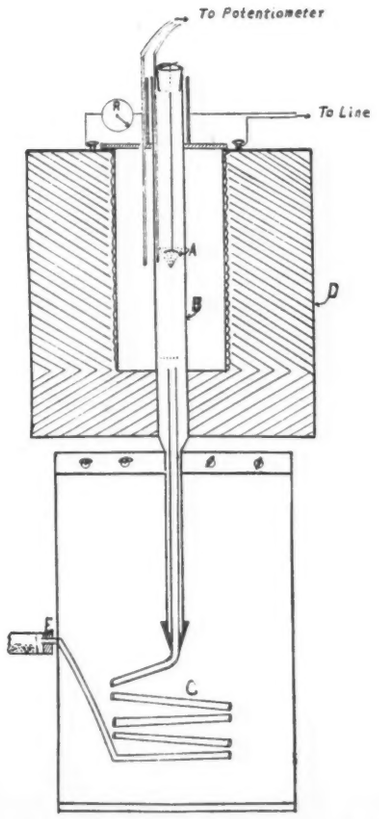


Figure 1—Calcining Portion of Apparatus to Determine Rate of Calcination of Limestone in Constant Currents of Air, Steam and Helium
A—Limestone charge in platinum filter cone
B—Quartz calcining tube
C—Superheating coil in Freas oven at 200° C.
D—Electric muffle furnace
E—Portion of the P_2O_5 tube through which the air and helium passed before entering the heating coil.
R—Rheostat in series with furnace

In order to obtain a direct comparison between the action of air and steam on the calcination of limestone, it was necessary for the conditions of experiment to be under such close control that no variable could affect the results other than the change from one gas to the other. The following factors must be under definite control: uniformity of the sample, method of calcination, temperature of calcination, and the velocity of the gas passing over the limestone.

The limestone used in this investigation was a high-calcium stone from Bellefonte, Pa., analyzing 97.7 per cent $CaCO_3$. It was sized to —3.93 mm.

*Presented before the Syposium on Lime at Richmond, Va., May 14, 1927.

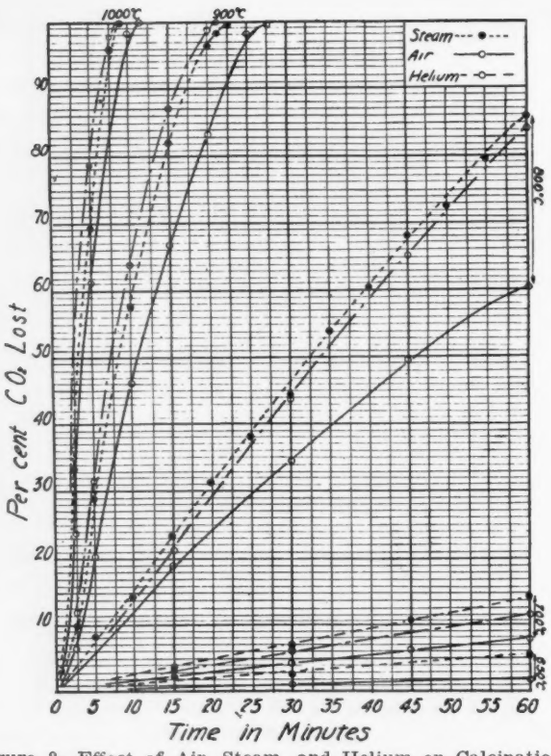


Figure 2—Effect of Air, Steam, and Helium on Calcination of Limestone

(5 mesh) and +2.36 mm. (8 mesh), thoroughly washed to remove all fine material, then dried at 125 degrees Cent. and placed in an air-tight container, where it remained until tested. Two-gram samples were used for each test.

Calcination was accomplished in a quartz tube (Figure 1) which extended through the center of a vertical muffle furnace. The samples were placed in a platinum filter cone and covered with a piece of platinum gauze so that there would be free passage of air both to and away from the sample without any possible loss of stone from decrepitation. A perforated plate in the lower portion of the quartz calcining tube prevented any irregular air currents from reaching the sample. After the weighed samples were placed in the filter cone they were suspended by a platinum wire to a definite depth inside the quartz tube, and allowed to remain for increasing constant periods of time from 2.5 to 60 minutes. The samples were then removed, cooled in a desiccator, and the degree of calcination determined by loss in weight.

The hot junction of thermocouple was placed in the quartz tube near the sample to insure definite control of the temperature during the calcination process. A second thermocouple placed outside the quartz tube assisted in the temperature control, so that it was quite possible to keep the furnace within ± 5 degrees Cent. of the temperature desired.

The velocity of gas passing over the sample during calcination measured 115 cc. per minute at 20 degrees Cent., and was the same for all gases used. The current of air was obtained from a reservoir by being displaced with a constant flow of water. The air was dried over phosphorus pentoxide before entering the calcining chamber. The constant flow of steam was maintained by forcing it at constant pressure through a capillary tube submerged in an oil bath. The capillary tube opened directly into the superheating coil which preceded the calcining chamber. The current of helium which was used in order to determine the effect of the physical properties of each gas was obtained from a standard-size cylinder and was dried by passing over the phosphorus pentoxide before entering the quartz tube.

Since the accurate measurement of this slow current of gas would involve considerable difficulty, especially in the use of steam, better results were obtained by a frequent check of the gas current and omission of the flowmeter. The rate of flow of air and helium was determined with a Victor Meyer apparatus while the flow of steam was checked by collecting the condensate and weighing it.

The results of this investigation are represented by the curves in Figure 2, where the abscissas refer to the time in minutes and the ordinates represent the degree of calcination or per cent of the total carbon dioxide lost. Sixty minutes was the longest time that any sample remained in the quartz tube and the lowest temperature at which there was any appreciable loss in carbon dioxide during this time was at 600 degrees Cent. This temperature of initial calcination was the same whether the limestone was heated in a current of air or steam. It will be noted, however, that at every temperature the rate of calcination was slightly greater in a current of steam than it was in an equivalent current of air. Particular precautions were taken to maintain all conditions of calcination the same whether air or steam was supplied to the limestone; still there was a slight difference in the rate of calcination in equal currents of the two gases.

No allowance could be made for the effect which the characteristic physical properties of each gas would have in transferring heat to the sample. Consequently, some tests were made with helium, which is inert as far as any chemical or catalytic effect is concerned, and it was found (Figure 2) that the rate of calcination in a current of helium was practically the same as in a current of steam. Therefore, it is quite evident that the favorable action of steam is not caused by any chemical action with the limestone during calcination.

The effect of steam has been attributed by some to its chemical and by others to its mechanical action.

The chemical action of steam has been ascribed to the fact that it would replace the carbon dioxide and thus assist in removing it. However, it is now known that the decomposition pressure of calcium hydroxide is much greater at any temperature than that of calcium carbonate, and therefore our physical-chemical knowledge of the properties of lime

points out that there is no possibility of the carbon dioxide being replaced by the water vapor under normal conditions. Furthermore, the results obtained in this investigation show that there is no evidence of a chemical reaction between steam and lime during the calcination process.

The mechanical effect of steam is supposedly due to its effect in sweeping the carbon dioxide out of the kiln so as to reduce its partial pressure around the stone, or to the fact that after condensing in the pores of the limestone its subsequent violent expulsion would open the pores of the stone and facilitate the removal of the carbon dioxide.

In the laboratory tests the velocity of all the gases used was the same, so that a variation in the partial pressure of carbon dioxide surrounding the stone could not have affected the rate of calcination. Furthermore, Knibbs has pointed out that a slight change in partial pressure would be of no advantage in a lime kiln: first, because the volume of steam makes up only a small percentage of combustion gases, and consequently would have only a slight effect on the partial pressure of carbon dioxide in the kiln; and second, this partial pressure would influence only the calcination of the outer skin of limestone, for thereafter the stone is always surrounded by a film of carbon dioxide and the interior of the stone decomposes in an atmosphere unaffected by the composition of the gases surrounding it.

The condensation of steam in the pores of the stone was not possible in the laboratory tests, since the samples were heated to 200 degrees Cent. before being placed in the calcining chamber. In a lime kiln the stone remains in the preheating zone for a considerable length of time, so that the interior of the largest lump must be heated to a temperature much higher than that necessary for the evaporation of water before the outside of the stone reaches the calcination temperature.

The advantage apparent in the use of steam can be explained neither by its chemical nor mechanical action. Thus the only remaining factor which could account for it is the difference in the physical properties of the gas through which the heat was transferred in reaching the sample. A brief explanation of the method by which the heat was transferred to the sample will show how the physical properties of the transferring medium could effect this reaction.

Under the method of experiment the heat transferred to the limestone was the result of the following factors: radiation from the quartz tube, convection of the gas currents surrounding the limestone, thermal conductivity of the gases, and the molecular heat capacity of the gases. The transfer of the greater quantity of heat would be the result of radiation and convection, and this would be the same for every gas used. The thin layer of gas between the quartz tube and the limestone sample, however, would permit the heat conductivity of the gases to function in the transfer of heat to the stone, and a slight drop in the temperature when the sample was first introduced into the calcining chamber would show that the molecular heat capacity of the gas surrounding the stone would also function in heat transfer. Therefore, there is every evidence to show that the difference in the heat conductivity and molecular heat capacity of the gases used would account for the difference in rate of calcination in the laboratory. However, if these factors do function in the heat transfer of a lime kiln, their action would not be sufficiently changed by the presence of 5 per cent of steam in the combustion gases to have any effect on the rate of calcination of the limestone. Whether the composition of gases over the fuel bed would be sufficiently changed by the introduction of steam under the grate to acect the transfer of heat to the stone, is a combustion problem which will be considered later.

The first appreciable loss of carbon dioxide from a high-calcium stone occurred at one hour's heating at 600 degrees Cent.

The limestone was calcined at a slightly faster rate in a current of steam than in a current of air, but this was due to the effect of the characteristic physical properties of each gas in transferring heat to the sample, and not to any chemical or catalytic effect which either gas had on the limestone during the process of calcination. It is pointed out that these physical characteristics would not affect the rate of calcination in the lime kiln.

The action of steam in the lime kiln is not limited to its possible effect on the process of calcination; its chief function is to control conditions in the fuel bed.

Steam has at least two and sometimes three distinct functions in controlling combustion conditions:

1. It may prevent packing of a low-grade coal so it can be made to burn almost as efficiently as the better grades.

2. It lowers the temperature in the fuel bed so that the utilization of a forced or induced draft does not produce the excessive temperature in the fuel bed which effects the clinkering of ash and destruction of grates. This action is brought about primarily by the large amount of heat which is absorbed by the endothermic reaction between steam or carbon dioxide and the incandescent carbon in the fuel bed.

3. It lengthens the flame, thus producing a more uniform temperature in the kiln and as a result a better grade of lime. The partial reduction of steam or carbon dioxide increases the percentage of combustible gases over the fuel bed. The secondary oxidation of these gases by the air which must be supplied over the fuel bed produces the long flame which is so effective in producing the mild uniform temperature much desired in the burning zone of a lime kiln.

USE OF FLOCCULATING REAGENTS STUDIED FOR THE RECOVERY OF FINE MICA

By W. M. Myers,
Associate Mineral Technologist, Bureau of Mines

THE principle of the application of electrolytes for deflocculation of fine materials in order that impurities may settle out, and the subsequent flocculation of the suspended particles by a different reagent, is well known and has been applied successfully to clays. Flocculation is also applied with success to ore slimes. Thus certain electrolytes, particularly alkalies, added to a suspension of colloidal particles cause deflocculation so that suspension may be maintained indefinitely. The addition of other electrolytes, particularly acids, on the contrary produces flocculation and the particles are rapidly precipitated from suspension, leaving a clear liquid above the precipitated mass. Salts of trivalent elements such as aluminum act similarly. Due to its cheapness the double sulphate of aluminum and potassium, ordinary alum, has been used extensively for treating clays.

Possible Applications to Mica

In the course of a study of the ground mica industry the writer was impressed with the waste of mica incurred through incomplete settling of the fine materials, and their irrecoverable loss when carried away in waste water. As finely ground mica is a high-priced product, attaining a value of $100 to $120 per ton, the losses from this source attain proportions that seem to demand a remedy. Experiments conducted by the writer indicate that the application of electrolytes might solve the problem.

The Ground Mica Industry

Before entering upon a discussion of the tests made, a brief review of the general features of the ground mica industry seems advisable. In the mining of mica a considerable tonnage of material is produced which is so damaged by rumpling, folding, the presence of impurities and lack of size that it can not be manufactured into sheet goods. In the early days of the mica industry this material was considered worthless and no effort was made to recover it. The discovery that ground mica produced from this scrap is of value to many industries has resulted in the profitable disposal of most of such material now being produced as a by-product at the mines. The supply of scrap mica from this source is augmented by the trimmings produced in the manufacture of sheets; by mica not suitable for sheet goods produced as a by-product in the operation of feldspar mines and clay pits; and by production from mines which are operated for scrap alone. This utilization of scrap mica has been a benefit to many mines, as it has afforded a source of additional revenue sufficient to justify the operation of properties which could not produce sheet mica alone in quantity having a value great enough to pay for the cost of production. The market absorbs from 5,000 to 9,000 tons of ground mica per year.

Grinding by Wet and Dry Methods

Scrap mica is prepared for the market by grinding either wet or dry. Although mica is classed as one of the soft minerals it is one of the most difficult to grind. This is due to the peculiar combination of properties of toughness, cohesion and flexibility which it possesses. The hammer mill is largely used for the manufacture of dry ground mica. The scrap, after being freed from adhering impurities and dried, is fed to the mill, where the beating action of the hammers rapidly disintegrates the mica aggregates. The ground material discharged through the mill screens is conveyed to vibrating screens or bolting machines and screened accurately to the desired size. Air classification is sometimes employed to remove impurities before screening. Much of the coarsely ground mica used in the manufacture of rolled roofing is prepared in this manner. Ground mica suitable for some other uses requires a finer and brighter product. This is prepared by wet grinding. Considerable quantities of wet ground mica are consumed in the manufacture of wallpaper, where it is applied by dusting over a previously applied adhesive which has been laid on in the desired design. The film of mica which adheres to the adhesive reflects light and brings out the design in a pleasing effect, particularly suitable for ceiling papers. For this purpose it appears to be an advantage to use wet ground mica, as this material is not roughened during grinding and each particle possesses a smooth surface which is a good reflector. This smooth surface is due probably to the fact that in wet grinding the sheets of mica are split along their natural cleavage and a smooth surface results which is protected from abrasion by the film of water surrounding it.

Early Wet Grinding Methods

The old style wet grinding tubs are simply short upright cylinders constructed of wooden blocks laid with the end grain exposed to abrasion. The impeller for stirring the charge is a wooden wheel which fits loosely within the cylinder. This is also constructed of wood exposing the end grain as

much as possible. The wheel is revolved by a vertical shaft connected to the driving shaft. As the capacity of one mill is small a number are erected in line in most plants so that they can be operated from one shaft which is driven by steam or water power. The cylinder is filled with cleaned scrap mica and enough water added to permit free motion of the charge. The impeller is then pressed down on the mass and started revolving. The friction of the wheel churns the entire mass around so that the mica is constantly split and worn down by the impact and friction of one piece on another. So much heat is developed by friction that continued operation raises the temperature almost to the boiling point. Grinding is slow, eight hours being commonly required for one run producing 300 or 400 pounds of ground mica. When grinding is completed the fine mica is washed out into launders and allowed to settle. Coarse mica is returned to the mill for further grinding. In the launders, which are long, shallow troughs made of either wood or concrete, the mica is permitted to stand until settled, the supernatent water is then drawn off and discarded and the mica is shoveled out and placed on steam coils or tables and dried. When completely dried the mica is conveyed to bolting machines and bolted through screens usually of 160 mesh. Over-sized material is returned for further grinding and the minus 160 mesh material is sacked for shipment.

Improved Wet Grinding Methods

The small capacity of these mills is an objection to their use, and they are gradually being replaced by more modern devices of greater size and efficiency. They utilize the same principle of grinding in that the mica is ground by mutual abrasion, but they are constructed on a larger scale and are provided with more efficient agitators which greatly increases capacity. The mills consist essentially of cylindrical steel tanks provided with wooden bottoms of end grain blocks. The dimensions vary, the maximum being approximately 10 feet in diameter and 36 inches high. Four wooden rollers in size approaching 30 inches in diameter with a 24-inch face revolve around a central shaft. The rollers are so arranged that their vertical position is variable and they can be fixed at any level, depending upon the height of the charge in the mill. Washed mica scrap is placed in the mill, water added, and the rollers lowered so that they are in contact with the charge. The rollers revolve at a comparatively low speed, and the mass is churned until grinding is complete. The ground mica is then washed out and the slurry discharged in concrete launders which lead to settling tanks, also of concrete. After settling the supernatent water carrying a portion of mica which has not settled out is led to another concrete tank for further settling. The mica is shoveled out and dried on steam tables and then bolted, the over-size being returned for further treatment. The loss of fine mica referred to in the introductory part of this paper is due to insufficient settling in the tanks.

It has been noted by some observers that more trouble was encountered from mica staying in suspension in concrete tanks than in wooden ones. This was most pronounced when new concrete tanks were put in use. The efflorescence of small amounts of alkali salts on concrete structures is of common occurrence, and it is believed that these salts went into solution and acted as deflocculating agents and helped to keep the mica in suspension. A similar phenomenon has been observed in the clay industry. This gradually corrected itself as the salts were leached out and finally removed completely in solution.

The condition of the water used for washing and grinding the mica would undoubtedly have great effect upon the behavior of colloidal particles. However, it was noted that in one of the mills in which the losses of fine mica were greatest the water was of exceptional purity, as it was obtained from mountain springs and contained so little material in solution that it was suitable for use in electric storage batteries.

Flocculation of Mica with Electrolytes

In order to determine the effect of electrolytes on the flocculation of fine mica a sample of commercial material was obtained. This was a composite sample and represented the average production of water-ground mica over a considerable period of time. The mica had been screened through a 120 mesh bronze screen, which is equivalent to a 160 mesh silk lawn. In order to remove the coarser material the sample was screened again through a 250 mesh screen. Four grams of the minus 250 mesh dried mica, equivalent to 4 per cent solids, was placed in a 100 cubic centimeter graduated cylinder, the desired amount of electrolyte added, and the water level brought up to the 100 cubic centimeter mark with distilled water. The entire mass was shaken up and then allowed to settle without disturbance. The effect of the addition of electrolytes was observed periodically and compared with a control test.

In preliminary tests made with mica and water alone the heaviest particles of mica sank rapidly and at the end of thirty minutes over 90 per cent of the material had collected at the bottom of the containers. Above this there was an opaque column of liquid in which the finest particles were in suspension. Allowing the liquid to remain undisturbed for 72 hours was not sufficient to permit complete precipitation of all the finest material which is colloidal in size. The addition of common acids and salts of aluminum resulted in rapid precipitation of all the particles, the rapidity of precipitation in very dilute solutions being in propor-

tion to the amount of electrolyte present.

Sulphuric acid, hydrochloric acid, potash alum, aluminum sulphate and chrome alum, in which the aluminum of ordinary alum is replaced by tri-valent chromium, displayed efficiency as flocculators. Choice of a proper flocculator is dependent upon cost and also upon its effect on the mica, as reagents injuring the quality of the product would be undesirable. Sulphuric acid, aluminum sulphate, and potash alum appeared most suitable. Typical tests with these reagents are as follows:

Four grams of mica in a volume of 100 cubic centimeters, was used in each test. Varying amounts of acid or aluminum salts were added as indicated in Table 1.

Table 1. Amounts of acids or aluminum salts added for various tests.

	Weight of acids or aluminum salts in milligrams.	Per cent of acid or aluminum salt (to dry weight of mica)	Equivalent to pounds of acid or aluminum salt per ton of dry mica.
No. 0 Control	0	0	0
No. 1	10	.250	5
No. 2	5	.125	2.5
No. 3	4	.100	2.0
No. 4	2	.050	1.0

These five tests were shaken simultaneously until all the mica was in suspension uniformly and then allowed to stand undisturbed. At the end of one hour results as determined by visual examination are given below.

Table 2. Results of sulphuric acid test at end of one hour.

	Height of mica column accumulated at base of test tube.		Condition of column of liquid above mica.
No. 0	1 in.	closely packed mica	Opaque from mica in suspension
No. 1	2 in.	loosely packed mica	Clear, no mica in suspension
No. 2	2 in.	loosely packed mica	Slightly cloudy
No. 3	2 in.	loosely packed mica	Very cloudy
No. 4	1.25 in.	loosely packed mica	Nearly opaque

After standing three hours little further change was noticed other than a slight decrease in the amount of mica in suspension in tests No. 2, 3 and 4. A similar test employing potash alum in place of sulphuric acid in the same percentage gave the results shown in Table 3.

Table 3. Results of potash alum test at end of one hour.

	Height of mica column accumulated at base of test tube.		Condition of column of liquid above mica.
No. 0	1 in.	closely packed mica	Opaque
No. 1	2⅛ in.	loosely packed mica	Clear
No. 2	1⅞ in.	loosely packed mica	Very cloudy
No. 3	1½ in.	loosely packed mica	Opaque
No. 4	1½ in.	loosely packed mica	Opaque

After standing three hours tests No. 2, 3 and 4 showed a slight decrease in the amount of mica in suspension. Similar tests with aluminum sulphate gave the results shown in Table 4.

Table 4. Results of aluminum sulphate tests at end of one hour.

	Height of mica column accumulated at base of test tube.		Condition of column of liquid above mica.
No. 0	1 in.	closely packed mica	Opaque
No. 1	2½ in.	loosely packed mica	Clear
No. 2	2 in.	loosely packed mica	Very cloudy
No. 3	2 in.	loosely packed mica	Opaque
No. 4	1¼ in.	loosely packed mica	Opaque

After three hours tests No. 2, 3 and 4 exhibited a slight decrease in the amount of mica in suspension. It is apparent that either sulphuric acid, potash alum or aluminum sulphate in quantities equal to 0.25 per cent of the dry weight of mica is a rapid and efficient flocculator.

In order to determine whether quantities of electrolyte less than 0.25 per cent but greater than 0.125 per cent of the weight of dry mica would act efficiently, a series of tests was run between these limits. It was found that efficient flocculation could be attained in one hour with quantities of acid or aluminum salts as low as 0.20 per cent, which is equivalent to 4 pounds per ton of dry mica. Below this point flocculation was slow and was not completed within a reasonable time.

Desirability of Settling Out Mica in Two Stages

It should be noted that in the control sample the mica settled in a closely packed mass which contained the coarser particles, while the finer material stayed in suspension indefinitely. In the flocculated material the mica was rapidly and totally precipitated, but the volume of the precipitated mass was nearly double that of the control sample. Allowing these tests to stand for days did not greatly increase packing. This is demonstrated in the following example: After the mica had been allowed to settled for thirty minutes, the control sample contained no electrolyte but showed a large amount of mica in suspension above a closely packed mass of settled material. The other tests which contained sulphuric acid in amounts equivalent to 4, 4.5 and 5 pounds per ton of dry mica displayed rapid flocculation.

The same tests at the end of twenty-four hours showed considerable mica still in suspension in the control sample. The other tests showed complete precipitation but the mass of settled material occupied a comparatively large volume. This is a disadvantage to flocculation, as this larger volume contains considerably more water which must be removed in drying. This may be avoided by allowing the mica to settle undisturbed until the heavy particles have settled out and then adding the electrolyte to precipitate the fine material still in suspension. This may be accomplished by adding and gently stirring either acid, potash alum, or aluminum sulphate solutions into the tank containing the mica, taking care to avoid any agitation of the mica which has already settled.

Conclusion

The results as recorded above represent laboratory tests only, and it is highly desirable to obtain corroborative evidence at mica grinding mills. Considering the low cost of the alum or other electrolyte, the simplicity of the operation, and the high value of the recoverable mineral, the method bears promise of successful commercial application.

A FAMILY PLAYTHING FINDS ITSELF

By F. A. Westbrook

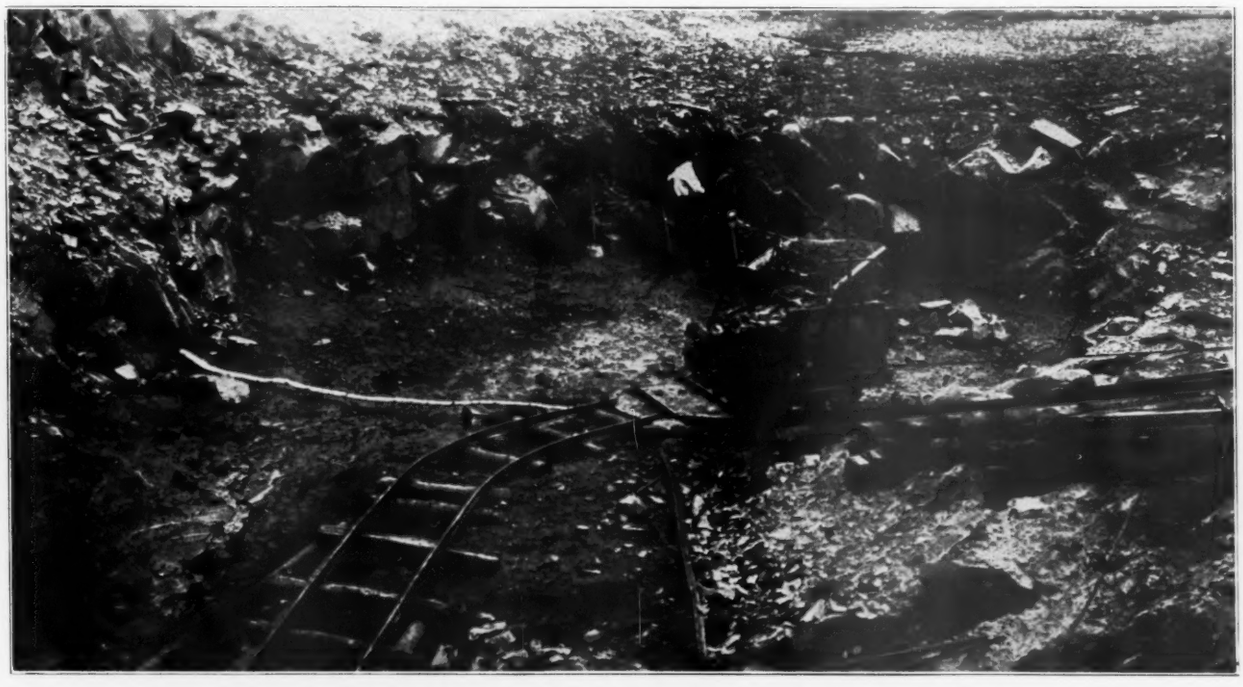
ABOUT a mile from Cheshire, Massachusetts, is located the operation of the Cheshire White Quartz Sand Company. This company was formed by James B. Dean in 1876, who never seriously tried to develop it, even though he realized the possibilities. The sand was dug out of a deposit of rotten sandstone about a mile from the plant, drawn to the mill and there washed. At that time it was only used for the bottoms of open hearth furnaces. His son, George Z. Dean, founded the Cheshire Lime Manufacturing Company and devoted most of his time to this industry. About this time the old source of supply was discontinued and the sand, this time of a soft stone formation, was obtained within a hundred yards of the mill. Very little attempt was made at quarrying, the stone being barred out where it could be obtained with the least difficulty. Because of the harder formation of the sand, a crusher had to be added at this time.

The next generation, Herbert W. Dean by name, was the first to develop the possibilities of the deposit. The preceding generations having exhausted the supply of easily procured stone, he opened a regular quarry and equipped the plant with a crusher, pulverizer and screens. The field for sand grew to embrace sand for coremaking and tumbling barrels, as well as furnace bottoms. After the quarry had been pushed back 200 yards, however, the stone became so much harder that the machinery could not stand up and it seemed as though the sandstone supply had been exhausted. This harder formation, which is technically known as quartzite, instead of proving a disaster opened up a new field. It was found that crushed to the size of egg coal and spread over the bottom of reheating furnaces in drop forging plants, it kept the billets out of the slag, protected the fire brick on the bottom and allowed an even heating of the billets. Meanwhile, the sand quarry was reopened on a lower level, and the regular sand business resumed.

Three varieties of stone are found at this plant, white sandstone, white quartzite and what is called massive white quartz, a very hard material which is capable of cutting glass. Analysis shows all three to be over 99 per cent pure silica and completely free from iron. The difference between sandstone and quartzite is, that though quartzite is the same analysis as sandstone it has been subjected to greater heat and pressure in its natural formation and is much harder and bluish in color, while the sandstone is pure white.

The sand quarry is about thirty feet below the surface of the ground, and is kept clear of water by a centrifugal pump driven by a ½ horsepower motor. The stone is fairly hard, a little harder than limestone, and has to be drilled by hand because the formation is so full of seams. Blasting is done with 40 per cent dynamite. The stone is then broken, loaded on cars, and drawn up the incline by an American Steel & Wire Company wire rope and Erie friction hoist driven by a 5 horsepower Fairbanks-Morse motor. These cars hold 1½ to 2 tons of rock.

The material is then taken to the mill where it is put through a number 3 Champion jaw crusher.



View of Quarry Showing White Quartzite Being Loaded into Dump Cars

Part of Quarry Where Quartz is Found. Note Irregular Stratification

Crushing Plant at Left and Storage Bins. Pipes are Part of the Dust Collecting System.

Under this there is a two-way chute, one to an elevator used to carry the rock to the storage bin; the other discharges to a Stephens-Adamson belt conveyor which carries the massive quartz and sandstone to an American ring-roll pulverizer. After the pulverizing, the material goes over the sizing screens. These screens, which are constantly shaken, were designed by this company and can be adjusted to various sizes, 3½ mesh for open hearth furnace bottoms, 20 mesh for core sand, and 3 mesh for tumbling barrels. The oversies are returned to the pulverizer. A Carlysle and Gail dust collector has been installed and the dust from this apparatus is used for silver polish and for mechanics' soap.

Formerly only the sandstone was used and was furnished to the glass industry. As the glass manufacturers moved to other parts of the country this outlet has practically ceased to exist. The result was a period of depression, but now several new markets have been developed which use all of the material found in the quarry. The quartzite is crushed into pieces of about the size which will pass through a 2½ inch screen, or about the size of stove coal. As it can stand a temperature of over 3500 degrees Fahr. without fusing it is very useful for the bottoms of drop forge furnaces, to hold the billet so that the flames may play around it. It has been found better adapted for this service than fire brick and is said to be used at practically every drop forge in New England and New York and to be rapidly spreading throughout the Middle West.

The quartzite quarry is adjacent to the sandstone quarry, the face being a little further from the mill. It is, in fact, the old quarry that was abandoned when the sandstone ran out. Owing to the hardness of this rock drilling is performed by hand. Even with hand drilling, and the drills tempered as hard as possible, they become dull after drilling only a few inches. Four feet a day is considered good drilling. The best results when blasting have been obtained by the use of 40 to 60 per cent dynamite. One blast from a single hole will often remove 100 tons. The formation of the rock is peculiar and very irregular with seams in all directions. The easiest way to get out the rock is to locate a keystone, blow that, and then a great

amount of rock either falls out or can be pulled down with crowbars.

After the quartzite is broken and loaded on cars it is run down to the mill, no need of a hoist, as the quarry floor is above that of the mill. The stone is put through the same crusher as sandstone, only the chute is turned so as to feed into a Link-Belt bucket elevator, which carries it to the storage hopper. The crushed quartzite is sold in various sizes, dust to egg coal size, chestnut to egg coal size. These different sizes are obtained by screening out more or less of the fine material while loading on to the trucks. The crushed quartzite is sold in barrels and bulk and the sand is sold in barrels, bags or bulk. The material is drawn from the plant to the railroad by Mack 2½ ton trucks.

Chemical Industries Exposition

One of the outstanding features of the last meeting of the Electro-Chemical Society in Philadelphia was a controversy upon the gaseous processes of reduction of metals from their ores, in which proponents from two important industries debated with keen interest what may eventually become a systematic procedure in the metallurgical industries. This discussion created wide interest and undoubtedly will lead to many interesting developments at the Eleventh Exposition of Chemical Industries to be held at the Grand Central Palace, New York City, from September 26th to October 1st, 1927. For the first time foreign exhibitors will show the latest developments in foreign chemistry, and already such interest is causing American industries to take notice of the competition from overseas.

The Students' Course under the direction of Professor W. T. Read, head of the Chemistry Department at the Technological College, Lubbock, Texas, is already developing much interest. It is contemplated to gather together all lectures delivered during the students' course and putting them in book form after the exposition to be sold to anyone interested.

Among other important functions held during the exposition will be the meetings of the American Ceramic Society, collaborating with the Students' Course program, and the meeting of the Salesmen's Association of the American Chemical Industry and some dozen or more organizations joining in the banquet to be held at the Hotel Roosevelt the evening of September 28th. The committee in charge is arranging details which will be announced later.

One of the principal features of the exposition will be the container section, which comprises: filling machinery; tanks, barrels and drums; labeling machinery; packing and weighing machinery; wood tanks and barrels; cooperage; fiber containers; metal and decorated cans and miscellaneous. A great deal of interest is also being manifested in new developments in grinding mills and the new developments all along the line in chemical engineering that will be shown. The authorities in chemistry and chemical engineering will discuss problems and explain new developments both domestic and foreign at this year's exposition.

Forecasting the Second Half

Following is a summary of the current views of leading economists and authorities on business conditions. The review of the many statements which led to this summary confirms belief in the stability of existing business. In spite of strikes, floods, spotty agriculture, and other factors, business in general is very healthy, and enjoys sound prospect for a continuance of good health.

Harvard Economic: Business should hold to something like present levels, or possibly increase during the next few months. The Japanese crisis is unlikely to have any important effect on the money market here.

Banker's Economic: The recent minor reaction in the stock market was followed, not preceded, by pessimism as to general business. Money still continues abundant, with no apparent indications of a change.

Brookmire: Steady reduction in volume of U. S. obligations, with a probable tax reduction, will doubtless stimulate business. Financing, which is at new high records, gives evidence of the large amount of available capital seeking investment.

Gibson: As general business should about equal that of last year, neither optimism nor pessimism is warranted. Declining commodity prices will have a favorable effect on the railroads.

Moody: Operations of our major industries are undisturbed and while serious the floods can hardly become a national disaster. Interest rates are showing a downward tendency, and this should continue for three months at least.

Babson: Business should continue in large volume during the coming months. While this means good production it does not necessarily mean industrial expansion. Sales figures for the next few months should approximate those of last year.

United Business Service: Remarkable stability in current business will likely continue unchanged for three or four months. Collections generally are no better than fair although money continues easy.

Poor's: General business should be favorably affected by building for some months to come. Unless the coal strike outlook changes, coal, coke and pig iron prices may be lower.

Alexander Hamilton: The present appears to be a period wherein the reaction of certain industries is offset by prosperity in others. Employment figures, as a whole, are only slightly under last year. The present position of commodity prices is one of general steadiness.

ROCK DUST FOR EXTINGUISHING FIRE

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PRELIMINARY tests referred to in this report were made at the Bureau's Experimental Mine under the general supervision of G. S. Rice, chief mining engineer, to determine whether rock dust may be used to extinguish or control mine fires.

Dust Used

The dust used for application by hand was made from draw slate taken from the Experimental Mine. This draw slate was crushed in a hammer-type crusher fitted with 1/16-inch by 2-inch slotted screens. A sizing test of the dust showed 96.5 per cent through 20 mesh, 69.4 per cent through 48 mesh, 46.2 per cent through 100 mesh, and 33.5 per cent through 200 mesh. The dust contained about 10 per cent combustible matter, 2 per cent moisture, and 88 per cent ash.

The dust used in the rock-dusting machine was made from shale taken from a bed about 60 feet below the Pittsburgh coal bed at the Experimental Mine. This dust contained about 2 per cent moisture and 1 per cent combustible matter. A sizing test of the dust gave 99.9 per cent through 20 mesh, 95.8 per cent through 48 mesh, 79.6 per cent through 100 mesh, and 62.7 per cent through 200 mesh.

Test Methods

In all of the tests reported the dust was applied either by means of a modern rock-dust distributor having a movable discharge pipe or by shoveling it on the fire by hand. In order that the workmen might not be exposed to danger and to prevent damage to the Experimental Mine, the tests were conducted at the mouth of the aircourse where the entry is lined with concrete and at a point where the smoke from the fire might be carried directly to the fan. With this arrangement it was possible to control the volume of air passing over the fire. When gas was used the tests were made outside of the mine; this was also done when lubricating oil was used.

Details of Tests and Results

Test 1.—In this test a rock-dust distributor was used. The fire was in the aircourse, 50 feet from the mouth. Forty pounds of kindling wood (pieces averaging about 2 inches square and about 2 feet long) were piled in the shape of a cone and in such a manner that it burned rapidly and made an intense fire. The machine was placed on the intake side of the fire with the end of the discharge-pipe 25 feet from the burning wood. About 26,000 cubic feet of air at a velocity of 450 feet a minute was passing over the fire. When the fire was burning at the maximum possible to obtain with this amount of wood, a stream of dust, estimated at 125 pounds a minute, was directed toward the fire for a period of three minutes. This was the heaviest stream obtainable from the machine. During this 3-minute period a thin coating of dust was deposited on the unburned portions of wood, but it had no effect on the fire.

Test 2.—Twenty pounds of kindling wood was added to the fire and the machine was moved so that the end of the discharge pipe was 15 feet from the fire. The ventilating current was the same as in test 1. The stream of dust was directed toward the fire for a period of 7 minutes. During this time the fire was enveloped in a cloud of dust so dense that observers could not see any signs of fire from a distance of 15 feet. When the machine was stopped the upper surface of many of the sticks of wood was coated with a 1/16-inch layer of dust. Some of the sticks were charred beneath the dust, indicating that they had been burning; but the general appearance of the fire at the end of this time showed that the dust had made little or no impression on it.

Test 3.—Conditions of this test were the same as tests 1 and 2. A new fire using 30 pounds of wood was started. The machine was placed so that the end of the discharge pipe was 20 feet from the fire and the stream of dust was directed toward the fire for a period of 5 minutes. The intensity of the fire was slightly reduced and there was a coating of dust about ⅛-inch thick on the upper surfaces of the top pieces of wood. About 50 pounds of dust (5 shovelfuls) was carefully placed on the fire, completely smothering the flame. Two hours later the mass had cooled to the extent that it was possible to hold the burned wood in the hand.

Test 4.—In this test a mine car containing about 500 pounds of coal, spread in a layer about 10 inches deep in the bottom of the car, was placed in the aircourse 50 feet from the mouth. The ventilation was the same as in the previous tests. The fire was started at the outby end of the car so that the ventilating current carried smoke and flame over the coal in the car. When about half of the coal was burning briskly the stream of rock dust was directed toward the fire from a distance of 30 feet for 25 minutes. At the end of this period the fire was gaining headway and there was a

⅛-inch layer of dust on the unburned coal in the car. Most of the dust appeared to have been carried beyond the fire. The ventilating current was cut down to about 500 cubic feet a minute and the rock-dust distributor again operated for 30 minutes. During this period the intensity of the fire was noticeably reduced. This may have been partly due to reducing the ventilating current. There was a 1 inch coating of dust over the front of the fire and about the same thickness over the unburned part of the coal toward the back end of the car, but there was no dust over the central part of the fire. A total of about 3000 pounds of dust was used in the two runs made in this test.

The conclusions drawn from this test are (1) that a high velocity air current carries the dust beyond the fire; (2) convection currents set up by the fire prevent dust from settling on the hottest part of the fire; and (3) operation of the machine for several hours with no air moving, as in a dead end, may result in the deposition of a blanket of dust that would have a retarding effect on fire.

Test 5.—Two timber sets made of old oak props were erected in the aircourse 45 feet from the mouth. The sets were about 5 feet apart and lagged with old props on the top and both sides. The clear space inside of the sets was about 5 feet wide by 5 feet high. A fire was started near the bottom on both sides at the outby end with kerosene-soaked waste. About 15,000 cubic feet of air at a velocity of 250 feet a minute was passing. The fire burned somewhat slowly for 10 minutes and the air was increased to about 26,000 cubic feet at a velocity of 460 feet. Twenty minutes after the fire was started all the side lagging and some of the top lagging on one side and about half the lagging on the other side was burning. The machine was operated with the end of the discharge pipe 25 feet from the fire and dust was discharged at the rate of about 80 pounds a minute, but the fire was not much affected in 5 minutes. The volume of air was reduced to 15,000 cubic feet a minute and the operation of the machine continued for 5 minutes. The fire was checked somewhat but the fire area was not much reduced. During the next 5-minute period the fire was checked a little more but blazed up again as soon as the machine was stopped. The ventilation was then reduced to about 500 cubic feet a minute and the machine operated 10 minutes. The main part of the fire was not much affected, but around the edges it was being quenched. A part of the dust used to this time fell to the floor short of the fire area. The machine was moved to a point 15 feet from the fire and after it had been in operation 3 or 4 minutes the entire set, including the lagging, collapsed. Fire was burning briskly in the collapsed pile of props and was quenched with water. About 2500 pounds of rock dust was used in the entire test but it had little or no effect on the fire.

Test 6.—In this test 1000 pounds of run-of-mine coal from the Experimental Mine was placed on a bed of kindling wood in the aircourse 45 feet from the mouth. The area covered was 5 feet square and the depth about 8 inches. Small quantities of pit-car oil was added from time to time after the fire was started to hasten burning. One hour after starting, about 80 per cent of the pile was burning briskly and two men began throwing rock dust on it, from a distance of 15 feet, with number 2 canal shovels. When 30 shovelfuls (300 pounds) had been thrown on the fire it was completely under control. It was left in this condition for 2½ hours, during which time it continued to smolder. Water was then thrown on the fire a bucketful at a time until 15 gallons had been applied. The first water thrown on the fire washed some of the shale dust down and the fire had a tendency to burn up again. On examination it was found that all of the coal was well charred; some near the front of the bed where the fire was started was coked.

Test 7.—In this test a wood and coal fire 24 inches in diameter at the base and 18 inches high in the center was made on the ground outside of the mine. After the fire had been burning for about 45 minutes a bucket (made from a 25-pound powder-keg) ⅔ full of pit-car oil was placed on top of the burning heap. When the oil began to boil over, the bucket was upset and made a very intense fire. Rock dust was then thrown on the fire by means of number 2 shovels. The first shovelful was directed at the oil bucket and it quenched the flame therein. About 400 pounds of dust was required to cover the fire completely and put it under control.

Test 8.—This is a group of three tests in which an attempt was made to determine whether rock dust would be effective in extinguishing gas flames. In the first two of these, flaming natural gas flowing from the open end of a 1½-inch pipe was extinguished by throwing rock dust at it by shovelfuls. In one of these tests the gas was flowing at the rate of 15 cubic feet a minute and in the other at the rate of 20 cubic feet a minute. In either case the flame was easily extinguished by a single shovelful of dust directed at the base of the flame.

In the third test a flat sheet of iron 6 by 5 feet was blocked up 5 inches from the ground with bricks placed at each corner. Three sides were packed with earth, leaving the fourth side open and about the same height as the kerf in the average undercut in a mine room or entry. The 1½-inch gas pipe referred to above was placed opposite the open side. With the burning gas issuing from the large opening along the side of this flat sheet of iron it was very difficult for one man using a number 2 shovel to extinguish the flame by throwing rock dust at it, but two men throwing shovelfuls simultaneously extinguished the flame at every attempt. Gas in this case was flowing at the

rate of 20 cubic feet a minute. With the gas burning as in the last case, rock dust was carefully placed, a shovelful at a time, so as to close the opening along the fourth side of the sheet iron. This crowded the burning gas to one corner and as the opening was being closed, the gas was forced through the earth filling around the other three sides. This caused the flame to spread over the earth filling, a small tongue of flame issuing at each little crevice in the dirt. In appearance, this fire was very much like gas burning over a freshly shot cut of coal and required the efforts of two men throwing rock dust simultaneously to extinguish it. After extinguishing the flame by this method three or four times, the gas was again ignited and rock dust was carefully placed over the loose earth to fill the crevices and concentrate the gas at one point. With the flame concentrated at one point it was an easy matter to extinguish it with a shovelful of dust.

Conclusions

1. The results of the tests indicate that rock dust may be used effectively for controlling fire when it may be approached and the dust applied direct. This applied to fires on the floor or in any position where it can be covered with dust. The quantity of dust required will depend upon the area of the fire.

2. The tests indicate that a blanket of dust 2 inches thick will be sufficient to shut off the air supply completely and smother the flame.

3. One of the chief advantages that rock dust has over water is that there is no steam to add to the discomfort of the fire-fighters, and it does not evaporate and permit the fire to burn up again.

4. In the case of burning gas, the flame may be gradually concentrated and finally extinguished when the gas is coming from the bottom or any place that can be covered with dust.

5. When the gas flowing from drill-holes at the working faces of coal mines has been ignited, the flame may easily be extinguished with a shovelful of rock dust, if the dust is so directed that it will momentarily interrupt the flow of gas.

6. In the experiments with the rock-dusting machine, the intensity of the fire was reduced in one or two cases but the results were not as encouraging as had been expected. The best results with the machine were obtained when the ventilation was reduced to almost zero.

Talc Production in 1926

The total quantity of talc sold by producers in the United States in 1926 was 181,568 short tons, valued at $2,110,994. according to figures compiled by the United States Bureau of Mines, Department of Commerce, from individual reports furnished by the producers. The figures comprise 5,988 tons of crude talc, valued at $26,723, 1,528 tons of sawed and manufactured talc, valued at $130,253, and 174,052 tons of ground talc, valued at $1,954,018. The total quantity was slightly less than in 1925, but the total value increased 5 per cent. There were 21 producers of talc in 1926, two less than in 1925.

Of the total quantity sold New York supplied 83,231 tons, valued at $1,030,075, as compared with 85,109 tons, valued at $993,913, in 1925; Vermont supplied 53,510 tons, valued at $514,527, as compared with 54,883 tons, valued at $533,603, in 1925; and California supplied 15,419 tons, valued at $233,292, as compared with 14,883 tons, valued at $194,975, in 1925. The remainder of the output was produced by Georgia, Maryland, New Jersey, North Carolina, Pennsylvania, and Virginia. Imports of talc for consumption in 1926 were 23,846 short tons, valued at $540,082. Corresponding figures for 1925 were 20,993 tons, valued at $450,532.

Fuller's Earth in 1926

The fuller's earth sold or used by producers in the United States in 1926 amounted to 234,152 short tons, valued at $3,356,482, it is announced by the United States Bureau of Mines, Department of Commerce, which has collected statistics in cooperation with the Geological Surveys of Florida, Georgia, Illinois, and Texas. This is an increase of 13 per cent in quantity and 15 per cent in value compared with 1925. Every important producing state except Texas showed an increase. The output was reported by 14 operators in 7 states in 1926, namely, California, Florida, Georgia, Illinois, Massachusetts, Nevada, and Texas. Georgia was the leading state in production in 1926, with Florida second and Illinois third. These three States produced 82 per cent of the total output. The average value per ton of fuller's earth was $14.33 in 1926 compared with $14.15 in 1925.

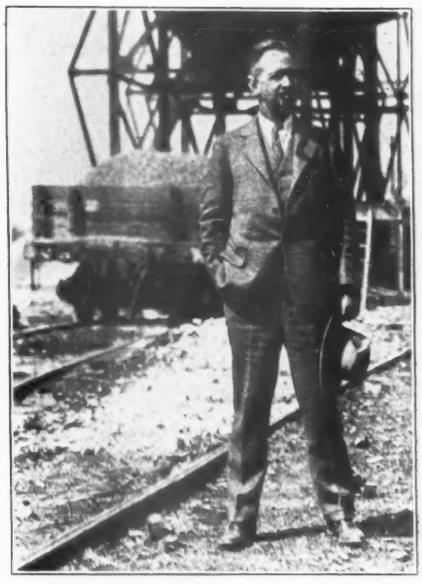
Fuller's earth is a term used to include a variety of natural substances that possess the property of absorbing grease or clarifying, bleaching, or filtering oil. They are mostly clay-like substances, though recently discovered material in the West, which is of different character, is said to be superior to the eastern fuller's earth. The original use of fuller's earth was in the fulling of cloth, but little of it is now used for this purpose. It is used almost exclusively in the bleaching or filtering of vegetable and mineral oils.

Until 1895, when fuller's earth was successfully produced commercially in Florida, the United States was entirely dependent on foreign supplies. In 1926 the imports of fuller's earth were 9,098 short tons, valued at $123,674, an increase of 14 per cent in quantity and 11 per cent in value compared with 1925. The exports of fuller's earth are not separately shown by the Bureau of Foreign and Domestic Commerce, but 5 producers reported that in 1926 they exported 6,650 short tons of fuller's earth, which was a slight increase over 1925.

MAULE OJUS ROCK COMPANY BUILDING SOLID FOUNDATION IN FLORIDA

The Maule Ojus Rock Company is located at Ojus, Florida, about three miles north of the city limits of Miami. It has four hundred acres of rock and consists of two complete crushing plants, each capable of producing 2,000 yards of crushed rock daily. The material is dug with two dipper dredges, one a 4 yard Marion dredge mounted on an all steel hull 44 x 110 x 8 feet deep; the other is a 1½ yard Marion steel dredge with a wooden hull. There are several miles of track at the plant and six locomotives are used to move the rock. The rock is reduced with a Williams number 8 Jumbo crusher capable of reducing 200 tons per hour from a maximum size of 30 inch to 1¼ inch and under in one operation.

The machine shop is one of the most completely equipped shops on the East Coast. It contains up to date equipment of various kinds including 150 ton wheel press, lathes of various sizes, shapers, steam hammer, electric welding outfit, and other necessary machines. The plant owns a fleet of ten 3½ ton Mack trucks which are kept busy hauling supplies locally; in addition extensive shipments are made by rail to various parts of the state.



E. P. Maule, President

This plant also makes a specialty of concrete products and has equipment capable of turning out 20,000 concrete tile, 20,000 concrete block and 50,-

The Hammer Crusher is Shown in the Center at Little to the Left

000 concrete brick daily. The company has recently installed a testing laboratory, with a very able technical engineer in charge, and is prepared to furnish architects and engineers with fine aggregates as well as coarse aggregates of any fineness modulus, or can furnish aggregates which will make concrete up to 4,000 lbs. compressive strength per square inch.

The quarry has been in operation for fifteen years, and has furnished about 75 per cent of the ballast used on the Florida East Coast Railroad, as well as a very large percentage of the rock used in highway building and building construction in south Florida.

The company make a specialty of cost accounting, and know each day the profits on the previous day's business. Their accounts are kept on a Burroughs bookkeeping machine, and a special study has been made of accounting so that after the trial balance is taken each month they are enabled to separate this trial balance in such a way as to render complete statements showing the cost of each operation, including their concrete products plant. The concrete products are all scientifically manufactured and are made to test better than 2,000 lb. per square inch. They also show a very low absorption test due to the fact that they are manufactured with exactly the right proportions of water, cement and well graded aggregates.

Arbitrate—Don't Litigate

The American Arbitration Society is steadily increasing its scope of activity and rapidly growing in popularity among manufacturers who have commercial disputes to settle. During the past two years, in a single industry, it is stated, more than 19,000 cases involving in excess of $4,000,000 have been arbitrated and thus kept out of the courts.

There are a number of very good reasons why arbitration is better for the manufacturer than litigation. In the first place lawsuits nearly always react detrimentally on commercial goodwill, while arbitration preserves intact that asset. This is because litigation is public whereas arbitration is private.

Our court dockets have become so congested with cases that years may elapse before a case entered today can even be heard. Arbitration proceedings are immediate, direct, and speedy. Furthermore, arbitration is flexible, while court procedure is, of necessity, very rigid.

In litigation it is necessary to educate judges and juries, if not the lawyers themselves, in the matter of individual and frequently highly technical trade practices. All such educational effort is dispensed with in arbitration, since the arbitraters are usually experts in the business in which the dispute arises. If for no other reason than these it must be evident that arbitration would prove much less expensive—and equally, if not more satisfactory.

Material Being Discharged at Plant by Truck

WHY H. D. JOLLEY PREFERS REINFORCED CONCRETE TO STRUCTURAL STEEL

REINFORCED concrete is sometimes condemned as being extremely variable in quality, and utterly uncertain; it is condemned as being extremely short-lived, and as a material incapable of rational design, and for these reasons it is urged that it be absolutely abandoned as a building material. This statement was made by H. D. Jolley in a talk before the Omaha Engineers Club. This article is an abstract of that talk.

It is utterly inconceivable to my mind that any engineering method or material could have enjoyed the consistent and marvelous growth in popularity which has attended the development and use of reinforced concrete during the past 25 years, unless it possessed inherent merit which commended its use to competent and responsible judges. Is it not remarkable that a material so complex and intricate in its structure and behavior as is reinforced concrete should have achieved such pronounced advancement during the relatively short period of 25 years?

On the score of reliability all materials are subject to failure. Hurricanes demolish wood buildings rather easily, and ordinary brick and tile walls are ready victims of an earthquake. Some failures of reinforced concrete structures are cited and we regret them all, but my off-hand judgment is that the collapse of the Quebec Bridge was the most terrible failure in the history of modern engineering.

As to permanence it is my idea that reinforced concrete is nothing else but. Who would say that our great football stadia are not reasonably permanent? When a structural engineer wishes to protect structural steel against fire, rust, and the weather he covers it with concrete. Certainly the weathering and spalling of exposed sharp edges of concrete out in the weather is not nearly so serious as is the problem of rusting of steel which can be so neatly cured by covering with concrete. Briefly, concrete is condemned as being an unreliable material, not permanent but constantly changing in its physical characteristics and not subject to rational methods in computing the strength of structural members.

As regards design, every structural member is either a beam or a column, and we have but to look around us to see innumerable concrete structures which we all know by test and instinct are absolutely safe. As a matter of fact we all know that tests show a very close relation between our theories and actual practice. Structural steel design and detail is not a pure abstract science itself. Certainly rivets do not act exactly as they are figured, and in general connections in steel are theoretically not as perfect as they might be. For instance, a butt joint in a column under ordinary shop practice is not a 100 per cent perfect affair.

I prefer reinforced concrete to structural steel for the following reasons: (1) Speed on the job, (2) adaptability, (3) permanence, (4) economy. Often before the structural steel arrives on the job, the whole concrete frame could have been erected in place. Even if the structural steel arrives on time the concrete frame can be and is erected just as quickly as the steel frame building. Changes in steel work occasion great delays on the job. Changes in concrete work never cause any delay. It seems to me that reinforced concrete is by far the more adaptable of the two materials. Certainly for footings, foundations and walls there can be no comparison. Concrete is easily molded to any desired shape. Skew and irregular shaped structures are difficult in steel, but in no way out of the ordinary in concrete.

Certainly nothing has ever been designed or built in structural steel to equal the strength, utility, and structural beauty of a flat slab type of building for factories, warehouses and heavy manufacturing buildings. The elimination of beams permits economy in height and convenient installation of shafting and other accessories, as well as providing a more even distribution of light. Last spring the M.Y.D. took bids on a service garage and warehouse building with alternate bids on steel and concrete frame. The building was built of reinforced concrete at a saving over steel of $60,-134, and in my opinion, gentlemen, it is a stronger building, more pleasing to the eye, and with more light, and all due to the flat slab construction and lack of beams.

As regards permanence I am sure we all regard concrete as an excellent material. Structural steel is entirely different. Even under cover it requires frequent painting to conquer its arch enemy, rust. We know that structural steel is a poor fire resisting material in the hotter fire, except when coated with concrete. On the score of permanence, therefore, why not build our buildings of reinforced concrete in the first place instead of encasing structural steel in concrete? A reinforced concrete building requires from 35 to 40 per cent as much metal as a structural steel frame building, with very little more concrete. It is therefore obvious that reinforced concrete is axiomatically the more economical of the two materials, and this theoretical demonstration can be tested any time by the bids of hard headed contractors fighting for business.

Two specific instances which I might cite will show you that differences in cost are very considerable. My first reference is to the Bankers Re-

serve Life Building here. The Selden-Brock Construction Company bid this job both on the basis of a structural steel design and reinforced concrete, and the concrete bid was $35,000 the cheaper. My second reference is to the Service Building of the M. Y. D. mentioned above. Here the saving was over $60,000 as revealed by the bids and in my opinion a better building was secured.

City Building in the New Business Era

City planning and building is rapidly erasing the imaginary corporate boundaries. The region, whether it be for a few miles around each small community or 50 or 60 miles around a metropolitan city, is now the unit for planning instead of the city itself. Almost over night have sprung up a number of regional planning bodies which are solving many of the planning problems in the great metropolitan centers throughout the United States.

In the region of Chicago a different science from the usual city planning scheme is being evolved and in two years has operated most successfully. Here the regional planners have forecast, first, the expected population in all parts of the region as far ahead as 1950; next, they have brought together the federal, state, county, city and village highway authorities to perfect a master highway and street plan which is being designed scientifically to care for the expected population. Similarly, subdividers, local city planners, surveyors and others have put into effect in over half of the eight thousand square miles in the region a requirement that these broad rights of way be dedicated by the subdividers when the land is platted.

Discovering that the amount of business property in use is directly in proportion to the population, the standard of fifty front feet of business property per 100 people has been adopted by subdividers and by zoning authorities to prevent the excess platting of retail business property and to keep it in relation to the expected population. Park areas are being located and playground areas designed in the right location for the expected population. These general facts have been assembled by the Regional Planning Association and are being made available to every community as they fit their individual plans together into a master regional plan.

Roadmaking Program in Greece

One of the first necessities of Greece is a system of good highways linking up the many points of commercial importance or of historical interest. Possibly 30,000 or more tourists come to Greece annually but remain usually not more than 48 hours, departing on the steamers on which they arrive, after inspecting the Parthenon and other monuments in and near th ecity of Athens. It has been apparent for a long time that if highways were available a large proportion of these tourists would remain several weeks, to travel here and there and to contribute substantially to the country's well being. A system of highways is even more important for ordinary economic purposes. Ways and means of providing good public roads now are under discussion, and on March 31 the Minister of Communications submitted to parliament two bills covering the subject.

One bill, general in character, deals with the construction and maintenance of roads, dividing them for these purposes into three categories: 1, national roads; 2, district roads, and 3, community roads. It provides that national roads shall be constructed and maintained at the expense of the state; district roads at the expense of the special road-making funds of the districts; and the community roads at the expense of the communities concerned.

Department of Commerce Reduces Management to Formula

A vast amount of study on business management and elimination of waste has been reduced to formula by the U. S. Department of Commerce. This formula appeared in the Department's news bulletin and consisted of eight rules which might well apply to any industrial enterprise. The eight points follow:

1—Define your purpose. You must know what is to be done before you can know how. This is your master task.

2—Analyze your problem. Your master task then will break up into many detail tasks. Consider them all. Neglect none.

3—Seek the facts. Study every condition governing each task. Find the undesirable element to be eliminated and the desirable element to be retained. Then standardize right conditions.

4—Devise the one best method. Aim to conserve energy, time, space, material. Determine relations of details to the master task.

5—Find the person best fitted. For each task certain personal qualities are essential. In each person certain qualities dominate. Find the person best fitted.

6—Teach the person best fitted the one best method. Not by driving, but by thorough, patient teaching are understanding and skill developed.

7—Plan carefully. Right planning of arrangement and sequence of work will enable you to accomplish tasks in logical order, accurately, quickly, economically.

8—Win co-operation. Co-operation means working together. It cannot be demanded. It must be won. Accept your share of the responsibility. Respect the right and aspirations of others.

RESEARCHES ON BITUMINOUS MIXTURES

By W. J. Emmons
Highway Research Specialist, U. S. Bureau of Public Roads*

DURING the past year research on bituminous mixtures has been vigorously prosecuted by a number of organizations. Although attention at present is focused principally upon the development of a test which will define the resistance to displacement of any mixture when subjected to conditions of service, the basic motive behind such research is the formulation of a rational theory of design of the substantiation of an existing theory.

At the Bureau of Public Roads two pieces of apparatus are in process of development which it is hoped will assist in the solution of the problem. Neither apparatus is perfected but it is felt that a description of the work being done should prove of interest at this time.

A machine which attempts to duplicate to a certain degree the action of traffic on a pavement surface has been designed for the purpose of determining the comparative strength or resistance to displacement of bituminous mixtures. The essential feature is a series of 11 steel cylinders or rolls, 4 inches in diameter by 3 inches long, mounted between and near the peripheries of two confining steel disks, which in turn are rotated by a motor. Beneath the rolls is a water-tight bath or tank in which is placed the specimen to be tested. At the beginning of the test the rolls are lowered gently to the surface of the specimen and the motor started. Rotation of the rolls takes place as they pass over the specimen, tending to deform it longitudinally. A certain amount of impact is also imposed as each roll leaves the specimen and the following one comes in contact with it. A small metal plate held lightly against the end of the specimen and connected with an Ames dial by a brass rod constitutes the device for measuring deformation.

The specimens are prepared by hand mixing and are compacted in a rectangular collapsible steel mold by means of an electric hammer fitted with a square tamping end. Specimens 8 inch x 6 inch x 2¼ inch have been used in most of the work thus far, although at present the behavior of a smaller size of specimen, 8 inch x 4 inch x 2¼ inch is being investigated. In each case the face of greater area is exposed to the action of the machine.

As might be expected, widely different test values may be obtained by varying the conditions of the test. An arrangement of the machine and of the specimen was sought which would give a wide range in strength values between weak and strong mixtures. The weight imposed by the rolls is susceptible to adjustment by means of counterweights to a maximum of 450 pounds, and the speed of rotation may be varied from 4 to 10 r.p.m. The degree of support provided the specimen under test greatly affects the results and it has been found best to confine it in a frame on the rear and two sides. The end toward which the movement takes place has at times been left entirely unsupported but it is probably better to insure against slipping of the entire specimen by providing small plates partially closing the fourth side of the rectangle. For the purpose of bringing out the effect of these many variables, rather than of deriving definite information regarding mixtures, many short series of tests have been run. The failure of certain specimens to check with the average of their respective groups may be due to lack of uniformity in their densities, or to certain other conditions of testing or molding which are as yet not clearly understood.

Considerable thought has been given to the method of interpreting curves of this nature. It is evident that data in this form are of little practical value without a knowledge of the degree of density to which mixtures may be compressed in service. Comparatively little information is available but a study is being attempted which it is hoped will shed light on the matter. As a step in that direction dry aggregate voids tests are being made on the aggregates extracted from samples of pavements of different ages, and the results of these tests are compared with the computed voids of the aggregate as it exists in the original sample. In sufficient work has been done to warrant definite conclusions, but from the tests which have been made, it is indicated that the voids existing in an aggregate may afford a measure of the compressibility of that aggregate when combined with bitumen.

Another device developed by the Bureau of Public Roads is a mechanical means for compacting fine aggregate mixtures in the test for voids. A steel disk 11 inches in diameter and 11/16 inches thick carries the aggregate containers and is vibrated rapidly between the lower and upper springs. Two cams driven by the motor are attached to the shaft, passing through the central column of the machine, alternately compressing and releasing the lower spring at the rate of about 1,500 times per minute. The throw of the disk is adjustable up to a maximum of 0.04 inches.

The disk of the vibrator is perforated with ten ⅝-inch diameter holes equally spaced on a circle concentric with its circumference. The bases of the containers are equipped with threaded rods by

*Paper read before the Fifth Annual Asphalt Paving Conference, Washington, D. C., November 8-12th, 1926.

means of which they are bolted to the machine. Either cylinders or cones may be used to contain the aggregate. Each container is fitted with a removable sleeve which may be attached to the container by spring clips or by threads. At the beginning of the voids test, the sleeve is attached, slightly more aggregate than is necessary to fill the calibrated container is introduced, a rubber shod cylindrical metal plunger is placed over the aggregate and the whole apparatus bolted to the vibrator. A 20-minute period of vibration has thus far been employed although it is likely that a somewhat shorter time may be sufficient to produce thorough compaction.

Considerable trouble has been experienced in obtaining a design for the containers which would resist the severe use to which they are subjected. The screw thread type has virtually been discarded since it was found all but impossible to prevent dust from seeping into and ruining the threads of the containers. The spring clip type seems to be more durable but as the holes in the clips wear larger it has been found necessary to take up the looseness which develops by wrapping and compressing a rubber band between the shoulder of the container and the sleeve.

Cylinders should be made by boring a solid steel rod in order to insure the greatest rigidity. Certain of the cylinders originally made have of late given erratic results and this has been traced to a very slight looseness which developed between the bases and the walls which, in this case, were turned out separately and assembled.

Most of the work has been done with cylinders one inch in diameter and of approximately 26 cubic centimeters capacity. Determinations by the method of hand tamping have been made concurrently with the machine test, using containers of identical construction for both purposes. Voids have also been calculated as they exist in 2-inch diameter cylindrical specimens of sheet asphalt mixtures compressed by the method devised by Messrs. Hubbard and Field. The aggregates of these specimens were combined with percentages of bitumen from 7 to 14 per cent.

Asphalt Repairs With Small Plants

Approximately six hundred fifty million square yards of mixed types of asphaltic surface roads are in service in this country. If the maintenance and patching area is 1 per cent per year it means that about six million five hundred thousand square yards are laid annually in small and scattered patches, numbering probably a million. In the Borough of Manhattan, New York City, for the year of 1925 there were openings totaling 78,532 square yards cut in the asphalt pavements for work on underground structures. This is a little over one per cent of the total area.

For the larger cities who have their own asphalt plants or who have sufficient work to keep a contractor with a hot mix plant in continuous operation, the question of repairs is not so difficult. For the small city, where a hot mix plant is not available, this repair work can be conveniently done by the use of one of the small plants for preparing hot mixtures, as well as asphaltic materials which can be handled cold.

The problem which confronts the engineer in charge of maintenance of asphalt surfaces of the hot mix type is the fact that patches and repairs are required at odd times and must be laid in small areas. The quantity of material required at any one time does not justify setting up and starting in operation a full size hot mix plant. Repairs in a sheet asphalt or an asphaltic concrete pavement should preferably be made with a hot mix of a similar grading and a slightly harder asphalt than that used in the original construction. There is no need for an opening to be left unpaved for any period, as a temporary patch can be readily placed. These may be of penetration type, or preferably a mixed type. Cold asphaltic binders may be used for this purpose.

The asphalt binders which can be mixed cold at ordinary temperatures may be classed into cutback asphalts and emulsified asphalts. Ready prepared asphaltic mixtures are also on the market which can be laid cold. The cutback asphalts are made from standard grades of paving asphalts which have been softened by combining them with a light petroleum product, such as naphtha or gasoline. These are workable at ordinary temperatures. About two-thirds of a gallon is mixed with a cubic foot of stone chips to form a paving material. It may be kept in stock piles for long periods and when needed can be readily spread out on the road surface in a thin layer. Initial stability is obtained through the mechanical interlocking of the aggregates when rolled.

The second class of asphaltic materials for cold working are known as emulsified asphalts. These are prepared by treating ordinary paving asphalt with a saponifying agent so that it will mix with water. They are handled in a manner similar to the cutback asphalts. It is not necessary that the aggregates be dry when mixed with emulsified asphalts. About one gallon is used for each cubic foot of aggregate. The latter can be made up of two-thirds of ¾ inch stone and one-third clean ⅜ inch screenings. Care must be used not to overmix when this material is used, as there is a possibility of the water and asphalt separating. Until recently freezing would also damage emulsified asphalt by causing their separation. However, a material is now on the market which overcomes these disadvantages and can withstand freezing weather without injury.

PIT AND QUARRY FOREIGN DIGEST

Sulphuric Acid from Gypsum

The Bambach process consists of the thermal decomposition of gypsum to sulphur dioxide. $CaSO_4 \longrightarrow CaO + SO_2 + O$. Basset's process consists of mixing finely powdered gypsum, clay and coal and ending with hydraulic lime and sulphurous acid. An intimate mixture of the finely powdered materials are introduced into a rotary kiln and burned in a current of steam. Part of the gypsum is reduced to calcium sulphide by the coal, and this reacts with the unchanged calcium sulphate, $3\ CaSO_4 + CaS \longrightarrow 4\ CaO + 4\ SO_2$. The steam in contact with the red hot coal forms hydrogen and carbon monoxide which act as vigorous reducing agents on the gypsum. It also prevents side reactions. Pure lime is not obtained as a burned end product but a cement, the composition of which is regulated by the coal added. Emming and Lake produce sulphurous acid from natural gypsum by heating it with a mixture of clay or sand, whereby with proper adjustment of the added materials, sulphurous acid and a useful hydraulic cement are produced. Bayer's process has achieved great success. According to this method the above mentioned mixture of gypsum, clay and coal is burned whereby a reduction of the sulphate to sulphide takes place, the latter being decomposed by the silicic acid with evolution of sulphur dioxide, which can be converted into sulphuric acid either by the chamber or contact processes. As a residue there remains a high quality cement free from calcium sulphide. The firing is done in a rotary kiln about 160 ft. long and 8 ft. in diameter similar to those commonly used in the cement industry. Heinrich Molitor (Chemiker Zeitung, May 4, 1927, pp. 329-332).

Fused Aluminous Cement

Fused aluminous cement may be manufactured without the use of bauxide by using clay rich in silica and heating in the usual manner for the preparation of aluminous cement but in the presence of substances which either dissolve or combine with silica. F. Krupp Grusonwerk A.-G. (German Patent 437, 242).

Active Form of Silicic Acid

The most important method of production is from soluble alkali silicates. Other methods involve the hydrolysis of $SiCl_4$, SiF_4 and SiH_4. Slag sand is also used as a raw material, being treated with acid. The silica sol formed by these methods is separated from insoluble products, gelatinized, and the gel dried. The excess alkali is washed out of the gel on the large scale by adding the calculated amount of aluminum or magnesium chlorides, the metallic hydroxide may be allowed to remain and the sodium chloride washed out, or the hydroxides may be removed by treatment with acid. Silica gel is used (1) for the separation of gasses and vapors from gas mixtures, such as sulphur dioxide, nitrogen dioxide, hydrocarbons, drying of gases and recovery of solvents; (2) in the refining of petroleum and (3) as a catalyst alone or as a catalyst carrier. O. Ruff & P. Mautner (Zeit. f. Angew. Chemie, April 14, 1927, pp. 428-434).

Accidents and Their Prevention in Concrete Construction

The commonest fault in concrete mixing is the use of too much water. Control by means of the slump test and the use of an inundator in mixing is recommended. Automatic regulation of the mixing process is recognized as essential. Accidents most frequently occur as a result of several causes no one of which would be dangerous alone.

Freezing is most dangerous at the moment of setting. Heating of the materials and of the work, protection of the fresh concrete have been the means in some countries of avoiding freezing, but coal is too expensive in France to be used in this manner. (Raoul Pascal in Le Ciment, April, 1927, pp. 122-132.)

Casting Concrete Under Water

The following precautions are to be taken in casting under water: (1) Use cement which sets as rapidly as possible, and a rich mixture, the mortar in excess of aggregate; (2) Cast the mass from that point which will avoid the horizontal joints as much as possible; (3) Do not interrupt the operation to avoid the oblique joints; (4) Avoid projections of the concrete, and the cement in the water in order to reduce the production of laitances to a minimum (5) Avoid the reentrance of water in the caissons used, and in all cases in reducing the disadvantages, prime each addition to the casting by means of plates of cement suspended in the interior of the caissons on which the concrete is added and which force back the water in front of them in the caissons in proportion to the descente of the concrete. Anon. (Le Ciment, April, 1927, pp. 133-135).

Cable Transport

Over really difficult country, a ropeway is often the only means of transport practicable, and in many cases it is possible to cut transport costs by the installation of a ropeway to carry the goods to the nearest railway, main road or other convenient centre for distribution. Ropeway transport is not affected by fog or snow, and the only form of bad weather that interferes with it is a furious wind. Roads, railways and rivers are easily crossed. They can be run at night as well as day. As compared with small gauge railway the cost is always cheaper for distances over 1,000 feet and in many

cases the ropeway will be cheaper over only a few hundred feet. The Monocable is the simplest form of ropeway. A series of loads is carried on an endless moving rope from the loading point to the point of discharge. The rope passes round a terminal sheave at each end of the ropeway, and is supported at suitable intervals by sheaves carried on trestles made of steel or timber. The Bicable ropeway differs from the Monocable type in the arrangement of ropes. The rope which carries the loads is fixed, and a separate rope is used for the return journey. The Monocable is suitable for a capacity up to 80 or 100 tons per hour where the grade of the rope is not steeper than 1 in 2½. The bicable is required for steep grades and large capacities. A. J. Knight (The Structural Engineer (London) May, 1927, pp. 155-161).

Points for Efficiency in Concrete

(1) Selection of a high grade finely ground cement, which should be used quickly, and stored as short a time as possible. (2) The use of a definite quantity of water per batch, and the frequent use of the slump test as a check. (3) Selection of a suitable graded sand, and washing it if not absolutely clean. (4) Selcetion of a suitable graded coarse aggregate, and using the maximum size possible for the work in hand. (5) Mixing time to be not less than two minutes. (6) Care to be taken to ram and rod the concrete to expel air. (7) If possible, keep the concrete in a damp condition for three weeks. G. McLean Gibson (The Structural Engineer, April, 1927, pp. 167-174).

Catalysts for Hydraulic Mortars

Salts or oxides, which influence the velocity of setting of hydraulic mortars, especially calcium chloride, soda lime, and calcium sulphate are mixed with special colloidal solutions such as colloidal silicic acid, and by means of evaporation or similar means brought to the required dryness and then ground with the hydraulic mortar. Evaporated mixtures of calcium chloride and colloidal silicic acid may be stored unchanged. Skanska Cement—aktiebolaget—Sweden (French Patent 609,768).

Fireproof Magnesia Brick

Magnesia brick, fireproof, mechanically resistant, unaffected by temperature fluctuations are made by the use of magnesite or magnesia in molten and disintegrated form. The magnesite or magnesia, containing as little as possible iron or lime is melted in a special manner, then disintegrated and grained, and then molded by the addition of the finest ground molten magnesite as mortar. The product thus produced possesses a resistance to fire well over 2,000 degrees C. Dynamidon Werk Engelhorn & Co. (German Patent 437,106).

Drying Apparatus

A very simple drying apparatus is the shaft type drying kiln. This has great capacity, is very cheap and is very economical in operation, although it can be used only for coarse pieces of solid materials, especially for minerals which are dried in large masses. Direct fire is used for heating and the gases mixed with the proper quantity of air pass through the interior of the drum. The largest apparatus of this kind will evaporate 6,600 pounds of water per hour. Anon. (Zement, April 28, pp. 339-341 and May 5, pp. 363-364).

Construction Prices for 1927

Building contractors throughout the United States are receiving this year approximately $7.16 per square foot of floor area for their work in erecting new buildings. A year ago contractors were paid at the rate of $7.27 per square foot. The present rate represents a decline of approximately one and one-half per cent of that prevailing in 1926.

These rates constitute an average of the contract values of all kinds of construction. The decline in contract price is parallel to a slight falling off in the amount of new work which is being undertaken.

The average contract rate per square foot was $4.62 in 1919. In the following year it rose to $6.34 but dropped to $6.06 in 1921. There was a further decline in 1922 to $5.78.

Foreign Trade Imports

Foreign trade of the United States this year shows improvements over 1926 in many respects, it is shown in data covering exports and imports of merchandise just compiled by the United States Commerce Department. Exports totaled $1,616,000,000 in value up to May 1, which represents a gain of $104,000,000 over 1926 for the corresponding period. Approximately $415,000,000 worth of goods were shipped out of the country in April, the highest export total for that month in more than six years.

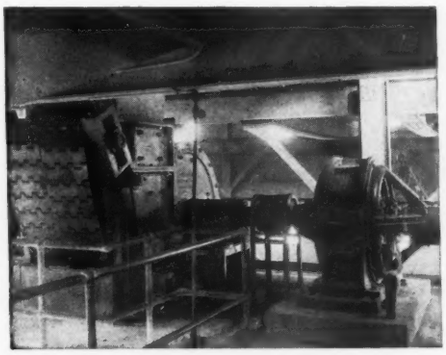
Imports amounted to $1,425,000,000 up to May 1. This was a decline of $220,000,000 in comparison with the corresponding period of 1926, but otherwise broke all previous records. The import trade of the United States last year was the greatest in the history of the country. Imports during April, 1927, totaled $378,000,000 or $20,000,000 less than in the same month of 1926.

Exports during the first quarter of 1927 were as follows: January, $419,000,000; February, $373,000,000; and March, $409,000,000. On the side of imports the totals for 1927 were reported by the Commerce Department as follows: January, $357,000,000; February, $311,000,000; and March, $379,000,000.

Swing Hammer Mills

Swing hammer mills have been made by many manufacturers and have been used for years in the non-metallic mineral industries. They are well known for service as secondary crushing units but they are designed also for primary reduction. During the past few years many installations have been made where these machines are doing primary crushing and often all the crushing in the plant.

From the beginning they have always had a larger ratio of reduction than any other crushing or pulverizing machine. The development of this type of mill has made it possible to take certain materials and reduce from 36 inch cubes down to 1 inch and finer in one operation. The use of the hammer mill has made it possible to reduce crushing costs to a very low figure due of course to the wide ratio of reduction which saves not only in first cost of installation of machinery but in power, maintenance and labor. One of the big features of the hammer mill is that it



A Hammer Mill in Cement Plant

will produce a cubical material and does away with slivers.

During the many years of hammer mills they have been used extensively on sticky, gummy or wet materials, and while they did prove practical they were not a total success. In order to better accomplish the crushing or pulverizing of sticky, gummy or wet materials, a radical change had to be made. Several manufacturers have worked on this problem with the final development of several successful machines made by different manufacturers. One machine with a patented feature has a moving breaker plate which has proved a success. Another machine is equipped with a roll in the front of hammer mill in place of a breaker plate.

The action of the hammer mill is to take the material, which the hammers take hold of, breaking and crushing the material on the breaker plate. If the machine is properly constructed most of the work will be done on the breaker plate. The material then is forced around to the cage or grate bars. All of the material that is crushed fine enough goes through the grates and the material that passes the breaking plates and hammers which is not fine enough is given more blows with the hammers until it goes through the grates. If the hammer mill is properly designed there should be very little work done on the cage or grate bars. By doing the work on the breaker plates where it should be done there is a saving in power and an increase in capacity.

The lumps of stone are first shattered by direct blows of the swing hammers and then further comminuted by a rolling and rubbing action between the ends of the hammers and the bottom of the hopper, called the breaker plate. This latter crushing effect probably continues to a limited extent between the hammers and the cage bars. Different sizes of product may be had by properly spacing the cage bars, but in actual practice only one bar spacing would be used at a time in any one machine.

Most of the hammer mills have adjustments to enable the user to get a uniform finished product. Each manufacturer has a different manner in which to make these adjustments and investigation should be made of these adjustments before purchasing hammer mills as it is very important to the operator. The adjustments have considerable to do with the power and maintenance costs. The breaker plates are attached to what is known as the front end which should be set at a proper angle to get the most efficiency from the hammer mill. This plate on all hammer mills has some adjustment and attention should be paid to the plate. The disc plates, which are the spacers for the hammers, are mounted on the shaft. These plates, on some hammer mills, have a series of holes for setting out the hammers as they wear. This is a good idea. Some mills also have an adjustable bearing.

On the discs, hammers are placed with a loose swing action. The weight of the hammer has considerable to do with securing the proper operation of the hammer mill as this weight affects the working of the mill.

The bottom of the breaker plate is adjustable to and from the hammers, so that it may be moved in as the latter wear and so maintain minimum clearance. As this adjustment is limited in range further compensation for wear may be made by setting the hammer hinge pins in holes nearer the circumference of the cylinder discs. It will be noted that a series of holes in the discs with gradually increasing distances from the center provide for this change. In another type of mill the main bearings are movable on their pedestals so that the whole shaft, cylinder and hammer assembly may be moved toward or away from the breaker plate. This adjustment has the objection that it does not readily lend itself to direct 4814 Pit & Quarry 6-6 Madigan coupling to a motor because of the difficulty of maintaining proper shaft alignment.

The extreme service to which the wearing parts of the hammer mill are subjected demands that they be made only of the best of materials. The breaker plate can usually be of chilled iron, but manganese steel seems to have the preference for hammers, at least for coarse crushing, and also for cage bars in the larger sizes.

As to the frame of the mill, there does not seem to be much choice of materials. One builder of the machine uses cast iron and cast steel with entire success, while another manufacturer makes the frame of rolled steel which is also perfectly satisfactory. The interior surfaces that are not directly involved in the crushing operation are protected by liners of white iron or manganese steel to minimize wear.

There is a sudden demand for considerable energy when a large stone is broken, and while much of this is stored in the rapidly revolving cylinder and hammers, not enough is available for work without slowing down more than is desirable. One and sometimes two heavy fly-wheels are mounted directly on the shaft especially for such service.

Like most other crushers, the output of hammer mills and the power taken by them depend on the kind of rock being handled. Most materials can be handled with the hammer mill unless very abrasive. At present these mills are built from 3 to 350 tons per hour capacity, size feed 36 inch size and under, with fineness from 1½ down to 95 per cent to pass 20 mesh. On some materials 50 per cent to pass 200 mesh can be secured.

It is not wise to use them on material harder than the denser limestones without very careful preliminary investigation, but on such stones and softer ones they are excellent machines. At present the largest unit available has a feed opening of 72x48 inches, runs at 600 to 700 revolutions per minute, and hence is suitable for direct coupling to a 60 cycle motor, and has an output of 200 to 225 tons per hour when reducing limestone to 1½ inch size. This is equivalent to passing from quarry run to ball mill feed in one step, and is a far greater ratio of reduction than is found in any other coarse crusher. The power required is about 250 horse power. Of course if a product of larger size is desired, such as 2½ inch for railroad ballast and heavy concrete work, or 6 inch stone for lime burning, it

may easily be had by a proper selection and spacing of cage bars. The hammer mill is also made in smaller sizes as a primary breaker and in other designs for secondary crushing.

In purchasing hammer mills attention should be given to the kind of materials to be used. Some concerns use grey iron castings for the main frame with manganese liners at every point of the interior and all parts can be machined and get a perfect mill. Other mills are made of boiler plate which is satisfactory and which also has liners at every point subject to wear. Consideration should be given to these different constructions and it is well to have each mill explained by the manufacturer particularly as to why they use certain materials.

New G. E. Developments

The General Electric Company has recently issued the following bulletins: GEA-140—CR1034-K1 describes hand-starting compensators for squirrel-cage induction motors, 5 to 15 h.p., 110 volts, and 5 to 125 h.p., 220 volts, 25, 50 and 60 cycles; 5 to 250 h.p., 440 and 550 volts, 50 and 60 cycles, and 5 to 125 h.p., 440 and 550 volts, 25 cycles. These compensators are suitable for starting two and three phase squirrel-cage induction motors, driving pumps, conveyors, compressors, blowers, etc. They are so constructed that they can be easily installed, readily inspected and economically operated, and at the same time furnish complete protection for both operator and motor.

GEA-416A—CR7051 describes automatic starting compensators for squirrel-cage induction motors, two and three phase, 5 to 30 h.p., 220 to 550 h.p. These motor starters are for remote control of constant-speed squirrel-cage induction motors that drive line shafting, pumps, compressors, blowers, conveyors, etc. Such equipment may be started or stopped from a distance by means of one or more push buttons located within convenient reach of the operator, or automatically by a pressure governor, float switches, thermostat, etc.

GEA-751 illustrates a combination trolley wire suspension and guard board support for mines. This new-type suspension fulfills all legal and safety requirements. It also offers an unusually rigid anchorage for guard boards; at the same time, a turn of the bolt with a wrench opens the clamps and releases the boards, thus making wire splices simple.

Edison Moves Boston Office

The Edison Portland Cement Company on June first moved their Boston office to the Consolidated Building at 250 Stuart Street.

Continental Dump Cars

The Kentucky Wagon Manufacturing Company has issued an illustrated catalog showing the design and construction and the advantageous features embodied in the Continental dump car, which they build in capacities ranging from one to 30 yards for 30-inch to 4-foot 8½-inch track gauge, of all-steel construction or with a wood body.

The bed of these cars is so constructed as to dump on either side of the track and is attached to the truck with hinges acting as rockers. The hinge attached to the bed is known as the top hinge, and that attached to the truck as the bottom hinge. The top hinge fits snugly into a solid base socket of the bottom hinge and a pin is placed through both hinges to keep them from separating. This construction does not permit the bed to separate from the truck and prevents the bed from rolling down embankments or over trestles. A patented hinge arrangement enables the operator to dump and right the car with the least possible effort. The wheels and axles follow M. C. B. specifications.

Mechanical Notes on Motors

The General Electric Company has issued a book under the above title known as the motor dealers' power manual OM-7162 which contains much interesting and valuable information. This manual discusses such subjects as location of motors, accessibility, atmospheric conditions where motors are being used, strength of motor supports, rigidity of supports, foundations and the like; methods of mounting motors; floor; pedestal; wall; ceiling; machine; mounting on bases, and vertical mountings; methods of mounting controls; machine mounting; mounting control beside machine and wall mounting. A number of practical methods of aligning motors are given when driven by belts, gears or direct connected. The book is well written and illustrated and the language used can be easily understood by both engineers and laymen.

Chain Belt Open New Chicago Office

The Chicago office of the Chain Belt Company, Milwaukee, Wisconsin, manufacturers of Rex Chains, Transmissions, Elevating, and Conveying Machinery, is now at Room 1515, 222 West Adams St., Chicago, Illinois.

It is believed that in this new location they will be in a still better position to be of greater service in that territory to users of the Rex Line as well as those of Stearns products. The Stearns Conveyor Co., Cleveland, Ohio, manufacturers of Stearns Idlers, Belt Conveyors and Rex Land Saver Systems was recently purchased by Chain Belt Co.

New Current Measuring Set

A split-core current measuring set that is especially valuable in determining the load on feeders or distribution net works has been introduced by the General Electric Company. The set is intended for use in determining the alternating current flowing in a conductor without opening the conductor to insert an ammeter or a current transformer to operate the ammeter. Each set consists of a transformer with a hinged magnetic circuit, leads, and one or more ammeters. It can be used to advantage when it is not required that the accuracy be of the order that can be obtained only with self-contained ammeters or portable current transformers and ammeters. A distinctive feature of the set is the ease with which the transformer can be clamped about the conductor. It operates with one hand like pliers, thus insuring safety for the lineman.

Battling the Gulf With an Odd Dredge

A hydraulic pump dredge of unusual construction was recently built by Jahncke Service, Inc., of New Orleans, for the Woods Brothers Construction Company of Lincoln, Nebraska. This dredge located at Gulfport, Mississippi, on the Gulf of Mexico, is now taking part in the great protective work of building a retaining sea wall 14 miles long, its particular duty being to fill-in back of the wall.

It is completely electrified, General Electric equipment being used throughout, and is one of the first complete installations of its kind. The equipment consists of a 15-inch Amsco centrifugal dredge pump driven by a 600-horsepower, 2200-volt, slipring motor. The hoist motors, pump motors and ladder motor, varying from 10 to 75 horsepower, operate on 440 volts. A substation is located on the shore, transforming power from 13,200 to 2300 volts. This substation is mounted on trailers so that it may be transported by a tractor. From the substation power is brought to the dredge through 2800 feet of 3-conductor, submersible, dredge cable suspended from tank type pontoons.

Oxford Plant Dismantled

The small plant operated at Oxford, N. Y., by Mortimer Windsor, has been dismantled. The capacity of the plant was about three cars per day.

INTIMATE NEWS OF MEN AND PLANTS

New San Diego Cement Plant

It is reported that a new cement and lime plant at San Diego, California, known as the Rock Chemical Corporation, will begin burning lime at the old magnesite factory in Chula Vista much sooner than anticipated, according to O. D. Thomas, head of the Chamber of Mines. which obtained the location of this industry. Motors totaling 325 horsepower are being installed by the Southern Electric and grinding units now are ready and within a few days, the big 80-foot rotary calciner will be ready to operate.

According to Mr. Thomas the Rock Chemical Company, in addition to manufacturing high temperature cement, the principal material for which will be pumped from the bay, will also develop the non-metallic resources of the county, making such products as clay pigments, filter clays, mica for insulation, powder bases. absorbent materials and fillers for decorative paper manufacture.

All the raw materials for this industry will be mined in San Diego and Imperial counties by local capital. The 8000 square miles constituting San Diego county and part of Imperial county form the most highly mineralized section in the United States, according to a local Chamber of Mines report, and the non-metallics in this area are especially rich and diversified. The Rock Chemical Company already enjoys substantial fertilizer business, materials for which is being manufactured from the marine marl deposits of Mission valley.

New Montana Cement Project Well Under Way

According to a report from Lewistown, Montana, preparations for the proposed quarter million construction program of the Three Forks Portland Cement Company at Hanover this summer are well under way. Under the direction of J. C. Capper, manager of the Hanover plant, tests are now being made of the structural formations of seven different hills supposed to contain gypsum or cement rock in large quantities. One of these seven tests has already been completed.

These tests consist of a series of eight holes drilled to a depth of 50 feet and placed at about 50 feet intervals across the face of each hill, and are intended to show not only the formations but the various caves and faults and thus demonstrate whether or not the particular structure tested can be mined or quarried on a paying basis. Following the completion of these seven tests, the reporting of the findings to the head office and the receipt of an O. K. from the head office to proceed, actual construction work on the electric railway bed which has already been surveyed will be started.

New Rock and Sand Plant in Southern California

A report says that completion of the modern $200,000 rock and sand plant in the San Fernando valley for the Sunset Rock Products Company, whose offices are at 326 Markham Building, Hollywood, California, has recently been announced by General Manager R. W. Clark. The new plant has a capacity of 2,000 tons daily. Storage capacity for rock and sand is 40,000 tons. A concrete tunnel, 180 feet long, costing $25,000, has been constructed at the plant for the drying of sand. A fleet of 42 dump trucks is maintained by the company.

Celite Awarded Final Decree in Patent Suit

The United States District Court of the Southern District of California issued a final decree in the suit filed by the Celite Products Company (manufacturers of Sil-O-Cel heat insulation) against The Featherstone Insulation Company for the infringement of United States Letters Patent 1,076,126 and 1,184,184.

The trial was held in Los Angeles last year, the final decree issuing on May 13, 1927. The court held both patents valid and infringed by the defendant. Patent 1,076,126 pertains to a molded diatomaceous insulating brick manufactured and sold by the Celite Products Company under the trade-name of Sil-O-Cel C-22. Patent 1,184,184 pertains to a composition consisting of a calcined diatomaceous aggregate (manufactured and sold by the Celite Products Company under the trade-name Sil-O-Cel C-3) and a binder. Very often the binder used is Portland cement, the resulting composition being known as Sil-O-Cel C-3 concrete. This product is used structurally, having a relatively high strength and at the same time good insulating qualities.

The court stated: "That a perpetual injunction issue out of and under the seal of this court directed to the said defendant, Feather-Stone Insulation Company, its workmen, agents, attorneys, servants, and associates, restraining them and each of them from hereafter directly or indirectly committing any of the acts of infringement aforesaid, or from directly or indirectly infringing or aiding or abetting others in infringing upon claims 1 or 2 or 3 of United States letters patent, No. 1,076,126, dated October 21, 1913, or from directly or indirectly infringing or aiding or abetting others in infringing upon claims 1 or 2 or 4 of United States letters patent No. 1,076,126, dated May 23, 1926."

The case was tried before Hon. Charles C. Montgomery, Master in Chancery, and the final decree issued by the Hon. William P. James, United States District Judge, Southern District of California.

Decatur Gravel Plant is Reopened

It is reported from Decatur, Illinois that the Decatur Hydraulic Sand and Gravel Company, located near the St. Louis bridge, southwest of the city, has resumed operations, after having been closed down for the last year or so. A new pumping boat has been finished and the entire plant is to be operated by electrical power. Complete screening and washing equipment is in use, turning out high grades of clean washed gravel and sand for all requirements. The deposit of gravel at the Decatur plant is considered very high quality, and varies from forty to fifty feet in thickness, and lies about four feet below the surface. The ownership has changed hands and Mr. Wm. Bowshier, who operated the old plant very successfully several years ago, is president of the new corporation and in active charge of the business.

C. W. Hay Now President California Association

At the second annual meeting of the Southern California Rock Products Association, held on May 3, C. W. Hay of the Blue Diamond Company was elected President of the Association, succeeding C. B. Rogers. In addition to Mr. Hay the following officers were also elected: F. F. Gay, Consumers Rock and Gravel Company, vice president; Paul Graham, Graham Brothers, Inc., treasurer, and E. Earl Glass, general manager.

Universal Portland Campaign Backed by B. F. Affleck

"June will be a no-accident month at the Chicago plant of the Universal Portland Cement Company if the safety campaign launched on June first in conjunction with 150 other cement mills and quarries throughout the United States brings the results expected," states B. F. Affleck, president of the Universal company. "A green and white safety banner, presented by the Portland Cement Association which sponsors the movement, was raised on June first at the plant's entrance. The banner will fly night and day so long as operation continues without an accident. Should an accident occur, it will be hauled down and surrendered." Over 3,500 employees at Universal's plants have signed individual pledge cards to keep the flag flying. Three safety meetings each week, verbal personal reminders to every worker once a week and bulletin boards which graphically show the cost of carelessness are some of the means used to combat accidents.

Celite for Concrete

The Celite Products Company has recently issued a booklet under the above title which discusses the proper use of Celite in order to obtain better concrete. The chemical and physical properties of this material are given and how Celite is used for various concrete mixes is described.

The advantages claimed for Celite are: Improved workability; uniformity and strength; water-tightness; bond and increased yield. The booklet includes illustrations of projects, some in course of construction, others completed, in which this material has been used.

Cement Plant Projected

According to a report a movement is reported to erect a $2,000,000 cement plant near Pikeville, Tennessee. Several Chattanooga business men are interested in the enterprise. The plant is to have a capacity of 2500 barrels of cement per day and will be located ten miles from Pikeville on the Old College Coal and Mining Co. property.

Iowa Quarry Changes Hands

It is reported that J. W. Corey and E. A. Collinson, of Davenport, Iowa, who for years have been associated in the management of the Bettendorf Stone Company Quarry at Bettendorf, have purchased that property from Louise Thomsen, executrix of the estate of Otto Thomsen. The Bettendorf Stone Company also operates a quarry in East Moline, Illinois.

Black Marble and Lime Co. to Erect Four Kilns

The officers of the Black Marble and Lime Company at Enterprise, Oregon, it is reported, are preparing revised plans, in consultation with E. W. Lazell, consulting engineer, for a new plant. C. A. Bingaman is president of the company. It is contemplated to erect at least four kilns near the railroad track east of Enterprise, the rock to be conveyed from the company's quarry on the mountain side by aerial tramway.

Material Firm Reorganized

According to a report from Cedar Rapids, Iowa, the Kirpatrick Building Material Company, located at 316 Ninth avenue, passed out of the business world of that city with the reorganization of the company into the Cedar Rapids Sand and Material Company.

Less than a year ago J. W. Kirkpatrick purchased the local company which has been known as the Consumers Building Material Company. The local field was carefuly studied and the possibilities of greater business with the activities of the company widened. In the re-organization, an incorporation was effected and J. M. Tallman and A. J. Kemper became directors of the enlarged company. Mr. Kirkpatrick remains as the directing head of the new business. The Cedar Rapids Sand and Material Company will continue in the supply of permanent building materials, and will add to its service the supply of washed, screened and graded sand and gravel for large structural projects.

Rotarians Hear About Sand

A craft talk on sand is reported as one of the features of a recent session of the Lankershim, California, Rotary Club. Mr. James Gautier, manager of the Consumers Rock and Gravel Corporation, told how a few years ago his company's teams were hauling from the river bed six tons of gravel and sand daily. Today this firm is handling 6000 tons daily. The sand is washed and dried. The rock is crushed and graded. The product is sold under a guarantee of quality and inspected to meet the requirements of the city building inspector.

Canadian Fire Loss

According to a report from Montreal, Canada, fire on May 21 caused a damage of $300,000 in destroying the buildings of the Maison Neuve Quarry Company, Ltd. More than one hundred men were forced out of employment by the blaze.

New Incorporations

Federal Sand & Gravel Co., Westville, N. J. $100,000 pfd., 1500 shares common, n.p.v. J. Rouse Burns, J. B. Van Dyke, Edgar C. Van Dyke, Philadelphia. (Corporation Trust Co., Philadelphia.)

Terry & Lewis Sand & Gravel Co., 311 S. Prairie Ave., Galesburg, Ill. $50,000. Mine and sell gravel. H. F. Campbell, W. E. Terry, Jr., W. E. Terry, Sr. (Wolsey & Lucas, Weinberg Bldg., Galesburg.)

Canton Building Stone Corp., Canton, O. $10,000. A. U. Bordner, E. J. Billings, William J. Schumacher, W. O. Marhofer, C. W. Kitcher.

Formisano & Sons, 921 Bergen Ave., Jersey City, N. J. Quarrying marble and stone. $100,000.

Penniman Gravel & Material Co., Dallas, Tex. $15,000. Gerry Penniman, Bruner R. Penniman, Harry Penniman, Jr., 3000 Junius St.

Sumter Lime Rock Co., Fred S. Scott, Jefferson Court Bldg., Orlando, Fla. $10,000. Chas. S. and E. Steward, Indian River City, Fla.

Wynne Sand & Gravel Co., Wynne, Ark. $65,000. D. H. Hamilton, Pres.; E. C. Bellamy, V. P.; S. G. Walker, Sec.; W. A. Pope, Treas.

John N. Box Sand Co., Illinois Corp. $3,000 cap. in Indiana; operate sand and gravel pits. Agent for service of process, Nels Anderson, Grisman, Ind.

Cedar Grove Sand Co., Fremont, Nebr. $25,000. J. A. Patton, Joe Becker, Guy C. Patton, W. S. Bailey.

Clematis Brook Sand & Gravel Co., Waltham, Mass. $25,000. Delbert S. Smith, Weston, Mass.; Chas. H. Hodge and John S. Lovell, Watertown, Mass.

Illinois Gravel & Construction Co., Rutland, Ill. John R. Cox, Lura Cox, John R. Cox, Jr., H. P. Haley. $150,000.

Olympia Sand & Gravel Co., Olympia, Wash. $30,000. G. D. Martin, Minnie E. Martin, John Bustrack.

Tri-State Talc & Mineral Corp., Glen Gardner, N. J. $100,000.

Lime Rock Asphalt Co., 1617 First National Bank, Memphis, Tenn. $12,000. W. T. McLain, John Brown, L. O. Dejach.

Paddleford's Plant Going Up

J. F. Paddleford has completed the foundations for his new plant at Sherburne, N. Y., and is awaiting the arrival of equipment.

The Monson Maine Slate Company, producers of genuine Monson slate, announces the removal of their executive and sales office to 38 Chauncy street, Boston, Massachusetts.

Jean Knox Now Consultant

The entrance into consulting engineering practice of Jean H. Knox, an associate member of the National Sand and Gravel Association, is brought to the attention of those interested in building design and construction. Since graduation from the University of Illinois in 1907, Mr. Knox has had a wide experience in engineering with a number of prominent firms in Illinois, Oklahoma, Texas, and on the Pacific Coast, engaging in the construction of buildings, roads, and bridges.

His service during the World War added to his engineering accomplishments through his work in the U. S. Naval Reserve Forces (aviation) at a number of naval bases and air stations. Subsequently Mr. Knox became engineer and assistant manager of the Continental Asphalt and Petroleum Company during which time his experience in asphalt road construction was considerably broadened.

His first contact with the National Association was as the engineer and manager of the Dallas Washed and Screened Gravel Company of Dallas, Texas. He is an active member of the American Society of Civil Engineers, Technical Club of Dallas, and the American Concrete Institute. We feel sure of the ability of Mr. Knox to fulfill successfully the offices of a consulting engineer and our best wishes go with him in his newly assumed activities.

John T. Dyer Quarry Company Makes Largest Eastern Shot

An unusual quarry shot, and one which attracted attention all over the East among explosives experts and stone men, took place on the afternoon of Monday, May 30, 1927, at the John T. Dyer Quarry Company's plant near Birdsboro, Pennsylvania. Approximately 170,000 pounds of 60 per cent and 75 per cent quarry gelatin dynamite were used. About 1,000,000 tons of rock were blasted out.

The face of the quarry which was blasted was from 250 to 280 feet high and about 800 feet long. Two types of loadings, both well drill holes and a large coyote hole, were shot at one time. The coyote hole was 105 feet deep, with six wings, there being three on each side. The total footage was 430 feet.

In back of the quarry face were 23 well drill holes. These were eight inches in diameter, the deepest one being 278 feet. There were 16 holes 200 feet deep and more. These holes were located at the side of the coyote hole, along the face of the quarry. Especially large size sticks of dynamite, seven inches in diameter by 24 inches in length were manufactured for loading. Each stick weighed 50 pounds.

The dynamite was supplied by the E. I. du Pont de Nemours & Company, and S. R. Russell, senior technical explosives man in the field for that company, directed the loading and the firing of the shot. He was assisted by John W. Koster and Edwin T. Wolf, also of the du Pont Explosives Department.

Water was used to tamp the tunnel. For this purpose some 80,000 gallons were brought from a nearby reservoir. A carload of stone dust was used for tamping the well drill holes. The shot, which was highly successful, was witnessed by a crowd of some 3,000 persons, including leading quarry men, explosives experts and visitors from surrounding cities and towns.

It was regarded as the largest quarry shot ever made in the East and the largest quarry shot ever made in hard rock in the United States. It has been exceeded in the amount of explosives used by other quarry shots in the Pacific Coast section, but these were in soft rock with lower grade explosives. It is also believed to be the first time in quarry blasting in the United States that two types of loadings were shot at once. Another unusual feature was tunnel blasting in a quarry face of the height of this one.

The quarry is one of the largest trap rock plants in the country and the stone blasted out is to be used for railroad ballast and concrete aggregate, for road work and general commercial purposes.

Marble Company Sets Record

The Gray-Knox Marble Company, Knoxville, Tennessee, recently established what is believed to be a world's record for fast drilling in marble when a total of 164 feet in depth was drilled in a period of two hours and eleven minutes with a new Gilman A. R. 521 automatic feed rock-drill. A total of 23 holes, each of 1 3/16 inch diameter were drilled to a depth of over 7 feet in the two hours and eleven minutes. This time included changing the drill and moving the drilling machine from one hole to another.

The average rate of drilling into the rock was approximately 15 inches per minute, but at times an actual rate of 26 inches per minute was made. Compressed air at an average pressure of 96 pounds was used to operate the drilling machine.

Lacona Sand and Gravel Suffers Damage

Early in April a trestle in course of erection at the plant of the Lacona Sand & Gravel Corp. was blown down and damaged to the extent of $1,000.

Britons Visit Ohio Quarry

According to a report from Marion, Ohio, Col. G. E. Smith and Sir W. W. Bigford-Smith, former vice-presidents of the Nobel Explosives Company, London, England, visited the quarry of John D. Owens & Son, at Owens, to witness an interesting blasting operation with Cordeau-Bickford, under the supervision of Byron Rice, general manager of the quarry. The operation included 132 holes and approximately three tons of dynamite were used.

New Carolina Cement Plant Plans Formulated

It is reported from New Bern, North Carolina, that Mr. R. C. Clark is making preliminary arangements for the construction of a cement plant there at an early date for the Carolina Cement Company. Although no definite announcements have been made, it is understood, pending the settlement of advance details, that the erection of a $3,000,000 plant is practically assured.

New Outdoor Switchhouses

The Westinghouse Electric and Manufacturing Company in the past three months has made several important and desirable changes in the design of its outdoor switchhouses, the most prominent of which is the reduction in height which gives a more compact single unit and also allows ready mounting under existing structures and busses. Another very desirable feature is the complete isolation of the front from the rear of the houses without decreasing accessibility. This assures a unit which is entirely dead front, neat in appearance, and rigid in construction. The meters and relays are now mounted on steel instead of slate panels which also provide additional bracing to the houses as well as eliminating the possibility of panel breakage. The circuit breaker control relay is mounted in a glass case, thus removing all danger of contact with live parts in the front of the house. This enables the central stations to utilize the services of a more or less inexperienced man to obtain meter readings without danger of physical injury from contact with live parts.

Roadside Pit Accidents

During the last nine months, three men have been killed in Central New York by caving sand banks, and all the accidents occurred in roadside pits. It should be made a criminal offense to cave a bank by the usual process of undermining.

New Hoist Motor

A new type RH, totally enclosed motor, rated at 5 hp., 15 minutes, 55 degree Cent. temperature rise, 1150 r.p.m., compound wound, 115, 230 or 550 volts, has been developed by the Westinghouse Electric and Manufacturing Company particularly for use on portable type room hoists in mines. Many designs and operating features make it especially applicable for this kind of service. Across-the-line starting is permitted with negligible disturbance at the commutator.

The armature coils are so constructed and installed that a single coil can be replaced with a minimum disturbance of the other coils. Each coil is specially insulated and the completed armature is thoroughly impregnated and baked, giving assurance of freedom from insulating troubles. The motor is rugged in construction, having a rolled steel frame and drop forged steel feet which are welded to the frame. The bearings are heavy duty roller type and the motor can be operated in an inclined position.

Asphalt Sales Increased During 1926

Sales of asphalt and asphaltic materials manufactured from petroleum at refineries in the United States during 1926 amounted to 3,458,470 short tons, which is an increase over 1925 of 9 per cent, according to G. R. Hopkins, of the United States Bureau of Mines, Department of Commerce. Of the total sales in 1926, 1,245,160 tons, or 36 per cent, was reported as having been produced from domestic crude petroleum and 2,213,310 tons, or 64 per cent, from foreign crude petroleum. The average value per ton of the total sales was virtually the same as in 1925, a decrease in the value of asphalt from domestic crude petroleum being counterbalanced by an increase in value of asphalt from foreign crude petroleum. The increase in the proportion of sales of asphalt from foreign petroleum in 1926 over 1925 indicates a tendency for the asphalt manufacturers to place more and more dependence on Mexican and Venezuelan crudes. The geographical distribution of petroleum asphalt production was unchanged in 1926, with the major portion of the sales on the Atlantic seaboard; the Gulf coast and California following.

Sales of natural asphalt and related bitumens, including bituminous rock, gilsonite, and wurtzilite (elaterite), at mines in the United States in 1926 amounted to 715,180 short tons, valued at $4,484,960, or an average of $6.27 per ton. This was an increase over 1925 of 22 per cent in quantity and of 8 per cent in total value, but was a decrease in average value of $0.82 per ton.

Imports of native asphalt and bituminous rock into the United States during 1926 amounted to 142,632 short tons, an increase over 1925 of 20,470 tons or 17 per cent. There was received from Trinidad and Tabago 76,562 tons, or 54 per cent of the total, and from Venezuela 46,292 tons, or 32 per cent. Imports from the former fell off slightly but the latter made a gain over 1925 as the result of much development work at the Bermudez Lake deposits. No imports of petroleum asphalt have yet been reported. Exports of asphalt were divided into three classes—petroleum asphalt; native asphalt and bitumen, unmanufactured; and manufactures of native. Exports of petroleum asphalt reflected the growing output at refineries and increased 65 per cent over 1925. The total amounted to 146,589 short tons, valued at $3,183,746. Exports of unmanufactured native asphalt in 1926 amounted to 38,218 short tons, a 16 per cent increase over the previous year. Exports of manufactured native asphalt declined materially in value from 1925, despite a considerable increase in shipments of roofing squares.

Barite and Barium Products in 1926

Sales of crude barite in 1926, as reported to the United States Bureau of Mines, Department of Commerce, by domestic producers. amounted to 232,875 short tons, valued at $1,743,293. These totals indicate an increase of 2 per cent in both the quantity and value of sales, as compared with 1925.

Of the crude barite, both domestic and foreign, consumed in the manufacture of barium products, 65 per cent was used in lithopone, 23 per cent in ground barite, and 12 per cent in barium chemicals. Foreign crude barite imported for consumption in this country in 1926 amounted to 51,016 short tons, valued at $195,004.

Combined sales of the barium products—ground barite, lithopone, and barium chemicals—by domestic producers amounted to 234,806 short tons, valued at $18,509,090, in 1926. As compared with 1925, sales of barium chemicals combined increased 17 per cent in quantity, sales of lithopone increased 10 per cent, and sales of ground barite increased 7 per cent.

The lithopone industry which recently has been confined to Illinois and the Middle Atlantic States was carried to the Pacific Coast by the establishment of a plant at Oakland, California, by the Chemical & Pigment Co., Inc. Missouri remains the center of the ground barite industry.

Safety Switch Bulletin

The Trumbull Electric Manufacturing Company has issued bulletin number 7 which includes a revised listing of residence and unit panels and supersedes all former listings of safety switches and panel boards. This bulletin contains much valuable information such as wiring data for motors and illustrated directions showing how to remove V-shaped twistouts.

Crude Barite Sold by Producers in the United States, 1925-26

State	1925 Short tons	1925 Value Total	1925 Value Per ton	1926 Short tons	1926 Value Total	1926 Value Per ton
Georgia	65,936	$475,618	$7.21	77,654	$532,706	$6.86
Missouri	101,056	794,927	7.87	118,919	946,595	7.96
Tennessee	47,012	345,038	7.34	20,910	155,780	7.45
Other States[1]	14,059	87,514	6.22	15,392	108,212	7.03
	228,063	$1,703,097	$7.47	232,875	$1,743,293	$7.49

[1]1925: Arizona, Nevada, North Carolina, South Carolina, Virginia and Wisconsin; 1926 Arizona, California, Illinois, Kentucky, Nevada, Virginia and Wisconsin.

Barium Products Sold by Producers in the United States, 1925-26

Product	1925 Short tons	1925 Value Total	1925 Value Per ton	1926 Short tons	1926 Value Total	1926 Value Per ton
Ground Barite	49,674	$ 1,040,461	$ 20.95	52,964	$ 1,121,631	$ 21.18
Lithopone	145,019	15,186,147	104.72	159,931	16,062,197	100.43
Barium chemicals:						
Carbonate	4,962	279,346	56.30	5,394	298,121	55.27
Chloride	(1)	(1)	(1)	4,592	279,510	60.87
Sulphate (blanc fixe)	11,748	792,036	67.42	(1)	(1)	(1)
Other[2]	1,944	136,388	70.16	11,925	747,631	62.69
	213,347	$17,434,378		234,806	$18,509.090	

[1]Included under "Other."
[2]1925: Chloride, hydoxide, and sulphide; 1926: Hydroxide, sulphate, and sulphide.

New S-A Speed Reducer

A recent introduction by the Stephens-Adamson Manufacturing Company is the "Speeducer," which is fitted with spur gears fully enclosed within an oil tight housing. Ratios vary up to 2000 to 1 for the standard sizes. These machines are built for capacities which range from 1 to 300 h.p. Important advantags which are claimed for these machines are: The small space required; proper alignment is insured with the gears and shafts all mounted in a single rigid case; all the gears are operated within a housing which does away with the expense of gear guards; all gears operate in a bath of oil at all times and correct lubrication is definitely cer- of cut gears and thus render dependable speed reduction service for long periods.

New and extensive equipment has tain; correct alignment and thorough lubrication add materially to the life been installed by this company to provide the latest facilities for producttwo separate drives: a Link-Belt silent chain drive from the high-speed ing gears of all kinds on a quantity basis. Along with the regular cast and cut tooth gear line there is a complete selection of speed reducers including the spur and worm gear type.

This company has published Catalog No. 27, which contains 224 pages of valuable data on gears, speed reducers, chains and sprockets.

General Electric Appoints

H. A. Couse, a member of the law Company, has been appointed general department of the General Electric counsel of the incandescent lamp department, with offices at 120 Broadway, New York City. Philip D. Reed will be associated with Mr. Couse at his New York office. F. H. Babcock, of the central station department, has been designated as assistant to Charles W. Appleton, who was recently elected vice-president in charge of general relations with public utilities.

Foote Bros. Officials Visit Sales Offices

W. C. Davis, president of Foote Bros. Gear and Machine Company, and Frank P. Callaghan, vice president and chief engineer, recently made a tour of the eastern sales offices of the company for the purpose of conferring with regard to the territorial questions and sales policies for the future. On their return trip, they attended the meeting of the American Gear Manufacturers' Association at Lansing, Michigan.

Clark Dust Collector

The Clark Dust Collecting Company has issued bulletin number 90 describing special dust collectors for recovering dust from kilns or waste heat boilers or dryers on any materials. The type of centrifugal collectors which this company builds is made in sizes to take care of as much as 100 to 125,000 cubic feet of air with one collector.

With these special design collectors it is claimed that from 90 to 95 per cent plus of all the dust in the gases can be collected. To handle from 50 to 60,000 cubic feet of gases per minute the number 80 collector is recommended, which is 20 feet in diameter and about 36 feet long. To handle 80 to 85,000 cubic feet of gas per minute the company recommends the number 90 collector which is 24 feet in diameter and 40 feet long, and to handle 100 to 125,000 cubic feet of gas the number 100 collector, having a diameter of 28 feet and about 50 feet high, is recommended. These collectors are equipped with special inner tubes and adjustable deflecting discs for regulating the gases as they pass through the machine, which assists in the recovery of the dust. Each collector is also equipped with a special vent to which is attached a short stack.

New Combination Hoist and Compressor

To meet the requirements of a definite class of steel erection jobs, where heavy, permanent installations of equipment are not practicable because of heavy moving charges, or where the tonnage to be handled is too small to warrant a permanent installation, the Novo Engine Company has developed a combination hoist and air compressor unit.

The use of this combination eliminates the necessity of having a separate air compressor unit for running the air tools essential in steel construction work, and requires only one engine to run both the hoist and compressor. The machine is mounted on a common frame, the engine being placed between the hoist on one end, and the compressor on the other end of the frame. The units are furnished truck or skid mounted, either single or double drum type, and with or without air receiver.

Falk Opens Chicago Office

The Falk Corporation, manufacturers of herringbone gears, speed reducers, steel castings, diesel engines and flexible couplings, have opened an office in Chicago at 122 South Michigan avenue. The office is in charge of Mr. C. H. Thomas.

New Electric Handsaw

J. D. Wallace & Company has recently introduced a new electric handsaw which is claimed to be efficient and powerful and at the same time absolutely safe and foolproof, the guard being locked in a position which covers the blade at all points. This guard has been accepted as standard by the Underwriters' Laboratories. When the operator wishes to cut he simply releases the safety guard by means of a trigger conveniently placed near the grip. When the saw is lifted from the work the guard drops automatically and locks in position, covering the blade, and will not open again until released by the trigger.

In use the handsaw is compact and convenient. One handle is of the type found on an ordinary handsaw, the other the same as that used in guiding a hand plane. Both are close to the point of work, insuring accuracy. A splitter follows the saw blade, drops into the cut and helps to guide the machine. An indicator in front makes it possible to follow a line, and the shoe is machined on one side to follow a guide rail. There is also a depth gauge so that the saw can be set to cut to any desired depth.

Smith-Booth-Usher Co. Enlarges Sales Line

Smith-Booth-Usher Company on May 1st of this year took over the stock and good will of the Los Angeles branch, known as the Contractors Equipment Corporation, of the Edward R. Bacon Company. The new owners will handle and distribute the many nationally known lines of equipment that were sold by Edward R. Bacon Company in Southern California.

The old company will continue to serve Central and Northern California through its main office in San Francisco and branch offices in Fresno, Sacramento and Oakland.

Lakeside Machinery Company Issues Machinery List

The Lakeside Machinery Company recently issued list number B-7 which contains details of new and used machinery which this company has for sale. This list comprises oil and gasoline engines, locomotives, locomotive cranes, cars and rails, electric motors, boilers, heaters and steam engines, air compressors, blowers, fans and exhausters, brick making machinery, hoists, quarry equipment, etc. A number of items of each class of equipment is given so that the intending purchaser can choose from a varied selection.

Walter E. Thau Promoted

Walter E. Thau, manager of marine engineering, general engineering department, Westinghouse Electric and Manufacturing Company, has been appointed director of marine engineering, according to announcement made by W. S. Rugg, vice president of the Westinghouse Company. Mr. Thau entered upon his new duties June 1 with headquarters in New York City.

Mr. Thau, who is well known throughout marine and electrical circles because of his pioneering work in connection with the Diesel-electric propulsion of ships, in his new work will coordinate all of the Westinghouse Company's engineering affecting the marine field and maintain engineering contact and service to the marine industry as a whole.

Stephens-Adamson Opens Canadian Plant

A complete manufacturing plant was placed in operation June first by the Stephens-Adamson Manufacturing Company, at Belleville, Ontario. From this branch factory there will be supplied the entire S-A conveying machinery line for the Canadian trade, in addition to a general export business to foreign markets.

In both the industrial and mining fields in Canada there has been an ever increasing call for labor saving machinery of S-A manufacture. The new facilities, which are very complete, will offer an opportunity for Canadian customers to purchase equipment of S-A design and reputation. This extension of S-A Service will be welcomed by S-A Canadian customers and those industries that are in the market for material handling labor saving equipment.

Mr. G. A. Freeman, for fifteen years associated with the main organization in an executive capacity at Aurora, Illinois, will be in charge of the new plant.

General Electric Company Elects New Officers

At the meeting of the board of directors of the General Electric Company recently at Bloomfield, New Jersey, where the board met following the practice of inspecting from time to time the different plants of the company, Clarence M. Woolley, chairman of the board of the American Radiator Company, was elected a member of the board of directors. Charles W. Appleton of the law department was elected a vice president in charge of general relations with public utilities.

All Steel Ball Bearing Induction Motors

A complete line of all steel, ball bearing polyphase induction motors, ranging in size from 1 to 100 horsepower in all standard voltages and cycles, is announced by The Lincoln Electric Company. This type of motor is representative of the new designs of equipment being brought out by this company in which gray iron and malleable castings have been replaced by hot rolled steel.

Owing to the greater strength of steel as compared with cast iron, less thickness of metal is required in the frame. It is claimed that the increased ventilation so obtained results in a considerable increase in the overload capacity of the motor, so that a continuous overload of from 10 to 50 per cent can be handled by the motors, depending upon the size and speed.

New Northwest Shovel

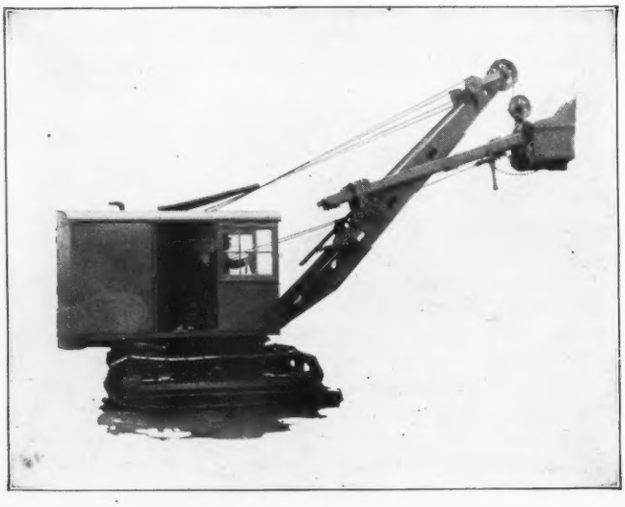
The Northwest Engineering Company has added another model to its line of gasoline and electric shovels, cranes and draglines. This new machine will be known as the model 3 and will have a capacity of ¾ cubic yards as a shovel, and handle a ¾ cubic yard clam shell bucket on a 35 foot boom as a dragline. Like all Northwests it can be fitted to handle a magnet or pile driver and the booms are interchangeable so that the machine is convertible from a shovel to a crane or dragline, and vice versa, by simply changing booms and without putting in or taking out crowding drums or chains.

The feature of maintaining positive traction on both crawlers while turning as well as while going straight ahead has also been incorporated. The side frictional strains that come with dragging a blocked caterpillar around are thus eliminated and the machine is enabled to go anywhere. All high speed shafts are mounted on self-aligning ball bearings, doing away with much of the usual attention to lubrication. The main drive consists of helical cut steel gears on ball and roller bearings and running in oil. The "feather-touch" control that utilizes the engine for shifting the clutches makes operation easy and assures maximum efficiency on the part of the operator. Special thought has been given to the dipper, which has an adjustable rake for grading and is wider at the door than at the mouth. The speed of discharge to trucks, etc., is increased and the complications of clogging and the necessity of constant shaking is avoided.

Forged Cast Gears

The Hill Clutch Machine and Foundry Company has recently developed a line of forged-cast spur gears. In this design the teeth are forged steel and a semi-steel hub. The construction is simply an annular forged ring in which is cast a hub, either with web or arms, depending on the dimensions. After casting the completed gear is finish machined and the teeth cut. Sound homogeneous teeth are provided with this construction. The forged ring is made of very tough steel. The junction of the steel ring and semi-steel center is a laminated weld of steel and iron and the finish gear is one integral piece.

The Gilbert Manufacturing Company of Aberdeen, South Dakota, has announced the removal of its plant and general offices to Stillwater, Minnesota.



New Northwest Shovel

Care of the Steam Boiler

By F. J. MacDonald

Plants are often being operated by steam, though this is being superseded by oil, gasoline or electric power by many concerns. Many of the nominally rated steam engines will exert a larger brake test than their rated power. One engine I have in mind, which was rated at 18 horse power would give a Prony brake test of 40 horse power. Then again by increasing the steam pressure an increase may be obtained; if the steam pressure is increased from 80 to 120 lbs. the power would be almost doubled.

We will now give a few suggestions on the care of steam boilers; in particular the tubular and fire box type used in most industrial plants. I remember the case of a neglected boiler that was used on a hoist in a quarry. This was a 50 horse power of the vertical type. Coal was piled against the boiler and often left there for long periods. After a while, by this want of attention, the action of the gases in the coal corroded the boiler so badly that it began to leak and it took four patches to put it into service again. A good prevention, in this connection, is to take out the grates and bars occasionally and also remove all the loose scale and give the boiler a coat of graphite paint. Leaks in a boiler should be given prompt attention. Flue sheets are often eaten away to half their original thickness by neglecting leaking flues.

Another example of boiler neglect was on the water leg, which had been corroded. This consisted of two small leaks which were repaired by an oxy-acetylene torch. However, the electric spot welder is better for this work and every plant of moderate size should have one of these equipments. Another defect on this latter boiler was the exhaust nozzle which had worked loose. This constant rocking of the nozzle had broken off the studs. However, by chipping and filling a new seat on the parts I was able to make a tight nozzle by the use of a new gasket and the insertion of new studs.

G. E. Changes Personnel

The election of three new vice presidents and the retirement of two executives of the General Electric Company were announced by Gerard Swope, president, following a meeting of the board of directors of the company in New York on May 25. C. C. Chesney, manager of the Pittsfield works, W. R. Burrows, associate manager of the Incandescent lamp department, and C. E. Eveleth, manager of the Schenectady works, were elected vice presidents of the company, taking on responsibilities in the manufacturing department. F. C. Pratt, vice president in charge of manufacturing, and H. F. T. Erben, assistant vice president of the manufacturing department, have retired.

The officers of the company were reelected at the meeting.

In conformity with the action of the board of directors of this company, an engineering council has been appointed. The council includes Messrs. E. W. Rice, Jr., honorary chairman (ex-officio); E. W. Allen, chairman; Elihu Thomson, A. C. Davis, W. R. Whitney, W. L. R. Emmet, C. C. Chesney and C. E. Eveleth.

W. S. Moody, in general charge of the transformer engineering department of this company since its inception, has been appointed a consulting engineer for all transformer departments of the company and for all departments of the Pittsfield works, E. W. Allen, vice-president of engineering, has announced. F. W. Peek, Jr., who has been a consulting engineer in the transformer department and in charge of the high voltage testing laboratory, has been named engineer of the general transformer department to succeed Mr. Moody.

Chester W. Rice, who has been engaged in development work in the research laboratory of the company, has been named assistant to E. W. Allen, vice-president in charge of engineering. Mr. Rice will give special attention to new developments.

New Centrifugal Pumps

The Dean Hill Pump Company has recently issued bulletin number 403, showing details of construction of the Dean Hill line of small-size double suction ball-bearing centrifugal pumps. These are made of more substantial design than actual operating conditions may require. The casing is of cast iron horizontally split, the parting flange being sufficiently wide to make a good joint. It is fitted with heavy bronze case wearing rings. The stuffing boxes are extremely deep and the packing glands are of bronze. A water seal ring is provided in each stuffing box. Heavy bronze throat bushings are provided at bottom of stuffing boxes.

The bronze impeller is of the double suction enclosed type, cast in one piece, and securely held in place. The ball-bearings are held in place by heavy shoulders on the shaft, and secured on opposite side by lock nuts. Deflectors prevent water, dust or grit from entering the bearings and oil from leaking out. The bearing housings are cast independent of the casing and are bolted and doweled to the bearing brackets. These pumps are made in 1, 1½, 2 and 2½ inch sizes.

A New Electric Siren

A new electric siren for use on fire trucks, ambulances, motor boats, yachts and so forth, is announced by the Federal Electric Company. The siren is of "streamline" design, and all visible parts, including the bracket and base, are heavily nickel-plated, giving a signalling device which adds considerable attractiveness to the car or boat on which it is installed.

The siren is entirely enclosed—is weatherproof—and is extremely simple in construction. The motor housing and horn of the siren are of spun brass. The base is of cast brass. The stator and rotor are die cast from high-grade aluminum. The Universal motor may be had in any voltage from 6 to 250 volts, inclusive. The siren may be adjusted in either a horizontal or vertical position.

In addition to the nickel-plated finish the siren may be had in brass finish—buffed, brushed and lacquered. The lead wire may be brought through the base or through a bushing on the side of the bracket—no wiring need be exposed. It has a sound radius of ¼ mile.

H. W. Hardinge Awarded Longstreth Medal

Mr. H. W. Hardinge has been awarded the Edward Longstreth medal by the Franklin Institute of the State of Pennsylvania for his invention of a rotary air classifier, known as the Hardinge Reverse Current Air Classifier. Only three awards of this medal were made this year.

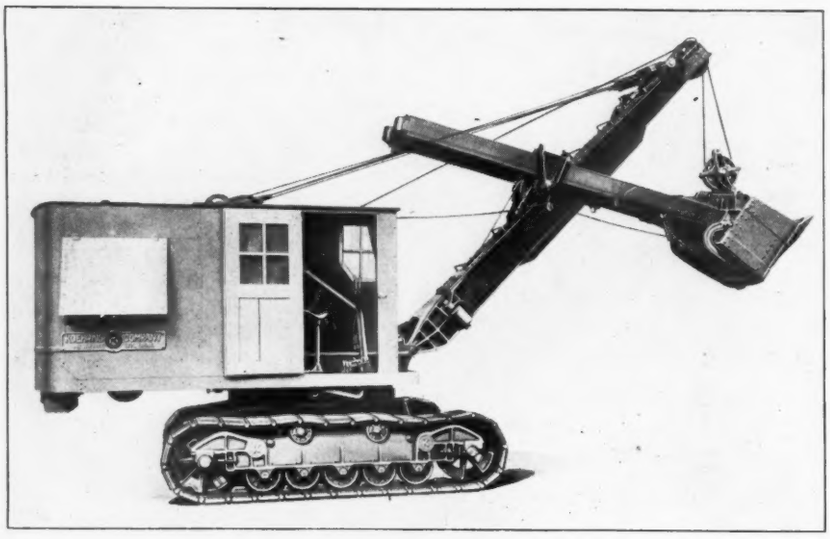
The committee appointed to investigate the invention, and its practical application to industry, reported in part as follows: "In consideration of the ingenuity of the device and of its usefulness in increasing the capacity of Hardinge mills and other mills of that type and of permitting a closer and more uniform separation of the product, the Franklin Institute awards its Edward Longstreth Medal to Mr. Harry W. Hardinge, of New York City."

Lincoln Electric Appoints

The Lincoln Electric Company announce the appointment of the Wade Engineering Company, Los Angeles, California, as distributor of Lincoln products in California, in charge of Mr. Henry N. Wade. This company also maintains a branch at 69 Webster street, Oakland, California, under the direction of Mr. H. T. Lintott.

New Koehring Shovel

The Koehring Company has recently issued a catalog describing and illustrating its new number 501 machine, which is built as either a shovel, crane, or dragline, and with capacities of 1½, 1¼ and 1 cubic yard. The choice of three sizes of dippers may be had, depending on the length of the dipper sticks and the work for which the machine is to be used. With 13-foot sticks a 1½-yard dipper is furnished; with 16-foot sticks, a 1¼-yard dipper, and with 19-foot sticks, a 1-yard dipper. In each case the boom length is 24 feet.



New Koehring Shovel

Special features making for increased output and economical operation are the Koehring shovel power dipper trip, the special swiveling boom point fairlead for the dragline, cast steel car body, multiplane girders and side frames, ball bearing mounted high speed shafts and roller bearing mounted vertical traction and swing shafts. The power is furnished by a Koehring Wisconsin four-cylinder 6x7 inch gasoline engine, with an optional choice of electric motor.

New Wire Cloth Book

The Newark Wire Cloth Company has recently issued catalog number 26 which supersedes former catalog number 25. It contains illustrations and data which are useful to the field. For example, it includes complete information on double crimped heavy steel wire screens; regular coal screens; steel wire cloth; bran duster grade of cloth; tinned mill screen cloth; brass, copper and bronze wire cloth; phosphor bronze wire cloth; Newark metallic filter cloth; monel metal wire cloth; testing sieves, foundry riddles, dipping baskets; and renewable bottom sieves.

Several pages in the back of the catalog are devoted to tables such as needed by users of wire cloth. Many photographs are shown to illustrate the multiplicity of weaves, spaces, and combinations used in the manufacture of wire cloth. The largest space listed is 4 inch x 4 inch and the finest is a twilled weave 325 meshes to the inch, the diameter of the wire being 0.0014 inch and the opening 0.0017 inch.

The newest development shown in the catalog is the gasketed metallic filter cloth of which this company are now manufacturing several successful types for flush plate and filter presses. These leaves are giving excellent service in a number of industries. The company is now preparing gasketed filter leaves in four ways, namely: by sewing a canvas gasket directly onto the metallic cloth; by edging the cloth with rubber, vulcanized in the plate; by giving the gasket a solid metal edge composed of soldering material capable of holding itself in place; and in some cases, by the application of a heavy red lead which will seal the joints effectively.

Blaw Knox Inundation System

The inundation system of measuring sand and water for concrete to insure absolute uniformity of mix is described and fully illustrated in an interesting booklet recently issued by the Blaw-Knox Company. The subject of constant concrete is of vital importance not only to those directly interested in its use, but also to those engaged in the production of each of its component parts. In the laboratory, under ideal conditions, where the nature of the ingredients can be carefully investigated and the correct proportions controlled as desired, concrete can be produced the strength of which may be forecast to a remarkably close degree. In such laboratory work the stone and sand are first carefully dried, and thus accurately measured. In actual work, however, such conditions do not prevail, and hence the need exists for an equalizing system whereby inconsistencies in the aggregate can be automatically overcome so that not only the first batch may be exactly according to specifications, but that each succeeding batch may be identical.

The Blaw-Knox inundation system and its mechanical proportioning equipment are designed to provide the necessary control to produce constant concrete on the job, laboratory-controlled, in a manner that is practical as well as economical, in any class or type of concrete construction. This is done by converting the fine aggregate from the conditions in which it is received on the job to a state of complete saturation with water, thus, regardless of the original moisture of the sand, introducing into the batch of concrete a constant quota of water in each batch. In addition to this water, the system is equipped to measure accurately the additional free water necessary to satisfy the total water requirements per batch of concrete or to produce a consistency of concrete as desired.

Traylor Rotary Screens

The Traylor Engineering and Manufacturing Company has recently issued a folder describing two installations of Traylor screens. The first is an 84 inch diameter by 24 feet inside discharge type rotary screen, with ball and socket trunnion, installed on the dredge Magic City, owned and operated by the Meteor Transport and Trading Company, Miami Beach, Florida. The screen has a jacket 18 feet long and handles five hundred tons per hour, separating into five sizes, washing the material simultaneously with the screening.

The other installation is a 72 inch diameter by 12 feet Traylor all-roller type, open end screen used at the plant of a lime and stone company. The barrel is made of steel bars, with openings six inches square and the screen produces kiln stone and fluxing stone at the rate of two hundred and fifty to three hundred tons per hour. Traylor screens may be secured in diameters 32 to 108 inches and in any length desired. Any size can be furnished of the inside discharge type.

Empire Association Meets

The Empire State Sand and Gravel Association held a meeting on June 8, at the Colgate Inn, Hamilton, N. Y. The business meeting followed the luncheon.

Universal Truck Crawler

The Universal Crane Company has issued an interesting illustrated bulletin, number 44, describing their motor truck crawler and showing how the mounting of the Universal crane can be changed in five minutes from truck to crawler. One man, it is claimed, can do this entire job in approximately five to ten minutes—run to the job on eight rubber-tired wheels—14 to 16 miles per hour—attach the crawler in five minutes or so and go in on the job without planking, regardless of soft ground, on a crawler that travels approximately 6 to 8 miles per hour.

When the mounting is used as a truck, the crawler track is carried over the wheels on a rack. In attaching it the front of the tread is pulled off the rack first and the truck driven slightly forward onto the tread. The rear end tread is then pulled off the rack and the truck driven forward until the crawler track feeds completely around the wheels. Then the truck front wheels are blocked and the truck engine clutch let in quickly to give the rear wheels a quick "kick." This pulls the end links of the tread together into place so that by putting a connecting tread pin through the end links the track becomes a continuous belt over the wheels. Next the tension spring is tightened up to give the proper tread tension, and the unit is ready to travel in on the job as a crawler. This device fits any 4-wheel Universal crane truck.

Recent G. E. Equipment

The General Electric Company has issued the following announcements of equipment: Bulletin GEA-6 describes squirrel cage motors for general purposes and to operate at constant speed. Type KT are 3 phase and KG 2 phase motors. These machines are made from 15 to 150 horsepower rating and with 220, 440, 550 or 2200 volts. They are continuous duty, 40 degree and skeleton frame design. Features of these motors are the oversize bearings, which are in dust-proof housings, insuring abundance of cool, clean oil at a low level.

Bulletin GEA-250 deals with drum type control equipment for two or three phase wound-rotor induction motors. These drum switches are recommended for non-reversing motors and may be used for starting or regulating duty, depending upon the resistor used. They are provided with auxiliary contacts which permit connections with either a magnetic contactor or oil circuit-breaker in the primary circuit to afford under-voltage protection. The resistor is so connected that the secondary of the motor is never open-circuited.

Another bulletin, GEA,-530A describes type MT control equipments for D-C series-wound crane hoist motors. This equipment consists of a panel, a resistor and a master switch. For motors up to 120 horsepower these control equipments provide five points power hoisting and six points power and dynamite lowering. For motors of 120 horsepower and above, they provide six points power hoisting and seven points power and dynamite braking lowering. Four points are hand controlled and the remaining are automatic.

Bulletin GEA-570 illustrates hand-starting compensators CR1034-K17, K21 and K22. These are of the dead-front cabinet type for squirrel cage induction motors, and are so constructed that they can be easily installed, readily inspected and economically operated, and will afford complete protection for both the operator and motor.

Bulletin GEA-753 describes a line of shoe type solenoid brakes for direct current motors. Six sizes are made which provide a range in braking torque from 0 to 3500 lb. at one-foot radius. They are suitable for use in connection with motors of 300 horsepower and smaller. Each size can be readily adjusted for any value of braking torque up to its maximum capacity.

New Caldwell Speed Reducer

The H. W. Caldwell and Son Company has recently issued a booklet, number 630, describing and illustrating the new Caldwell speed reducer, type "A" and type "B." This is a self-contained unit which combines shaft, and a cut spur gear drive to the low speed shaft. It is made in sizes to furnish reductions from 7:1 to 40:1 in type A or to 30:1 in type B. Type A is designed for general industrial uses, while type B is for screw conveyor service.

The silent chain drive, which is used for the first reduction from the motor, is a flexible, positive drive for high speed, and is claimed to have an efficiency of over 98 per cent. The second reduction is made by cut spur gears generously proportioned for the power requirements. The silent chain drive and the gears are both inclosed in dust-proof, oil-retaining housings, which keep them operating in a bath of oil, requiring very little attention. Timken roller bearings reduce friction. With this speed reducer it is not necessary to use a flexible coupling on the motor shaft. The silent chain drive provides the necessary flexibility between the motor and the speed reducer shaft.

New Atlantic Tankers

The Diesel-electric machinery is now being installed in the three tankers soon to be put in service by the Atlantic Refining Company. These boats, purchased last year from the U. S. Shipping Board, are being reconditioned for this purpose, and will be among the largest of their kind in the world.

The three boats, the "Sharon," "J. M. Connally" and "Bessemer," each have a dead weight of 7,000 tons. They were formerly operated by steam and, when completed, will be used in trans-Atlantic service. The "J. M. Connally" is being outfitted at the Point Breeze plant of the Atlantic Refining Company, Philadelphia, and will probably go into service by the latter part of June. The other two boats are being reconditioned by the Alabama Drydock & Shipbuilding Company at Mobile. Alabama, and will probably be in service sometime during July or August.

The power plants on each boat will consist of Ingersoll-Rand Diesel engines and electric equipment furnished by the General Electric Company. Each tanker will be equipped with three 850 horsepower, 225-r.p.m., Diesel engines, each driving a 525-kilowatt, 250-volt generator for propulsion and a 50-kilowatt, 250-volt auxiliary generator for excitation and ship's auxiliary power. The propulsion generators will supply power to an 1800-horsepower, 90-r.p.m., 750-volt double motor on each boat, direct connected to the propeller shaft. The control will be of the Ward-Leonard type arranged for operation either from the pilot house or the engine room, the panels being of the dead-front type throughout.

The tankers will be fitted with electric auxiliaries, all of which will be driven by General Electric motors. These auxiliaries will include two 80-horsepower cargo pumps, one 45-horsepower windlass, one 30-horsepower mooring winch, one 30-horsepower fire and bilge pump, two 15-horsepower air compressors, a balancer set and numerous small pumps—as well as a 25-kilowatt auxiliary generator driven by a small oil engine which will be used for emergency and in port.

E. L. Parsons Joins Foote

Mr. E. L. Parsons, formerly district manager for the Ramsey Chain Company, has recently joined the sales force of the Foote Bros. Gear and Machine Company, and has been appointed district representative for that company for the State of Wisconsin and northern Illinois, with headquarters at Milwaukee.

New Dust Arrester Vibrator

As is well known, the cloth screen dust arrester is one of the types of dust collecting apparatus now available for the installation in which continous operation or classifying is not essential. Owing however to the necessity of periodically freeing the screens from the dust which accumulates on them and which would otherwise impair the filtering capacity, it is essential every few hours to set in operation a rapping device which will vibrate the screens and thus shake off the dust into the hoppers below.

Hitherto this has been accomplished by means of spring pistons, either air operated or mechanically driven, and actuated by cams on a revolving shaft extending the entire length of the screen gangs. Such devices, however, are necessarily subject to a considerable amount of wear, especially as they are apt to receive as a rule little or no attention. Furthermore, unless the cams and the pistons are spaced fairly closely together it may happen that the screens situated between the shaking points may receive less than their proper measure of shaking. A further difficulty occurs in cases where the length of the screen gangs is considerable, because the longer the shaft the more difficult it becomes to eliminate spring and bending unless the shaft diameter is decidedly increased.

It is claimed that the screen-vibrator now being adopted as standard practice on all the larger models of the Norblo cloth screen type dust arresters manufactured by Northern Blower Company avoids these difficulties.

The design is different from all previous vibrating devices. It consists of a single electrically operated rapper which travels slowly on rails from end to end of the screen gangs, vibrating each individual screen thoroughly as it passes under it. Since only one rapping piston is required, this can be, and is, constructed in the most substantial manner, ball-bearings being provided throughout the device, and all parts being thoroughly protected from the surrounding dust by a substantial cast-iron case. All bearings are packed with many months' supply of grease, and the device is guaranteed to work without any attention or replacement of parts for at least one year from the date of installation.

The operating motor is fed from a pair of trolley wires by means of a double collector arm and drives the spring rapping piston through a bevel reduction gear. The gear shift carries a cam which operates the rapper against the action of a powerful spring, thus giving a rapid succession of upward blows to the under side of the screen gang frame. At the same time, the entire mechanism is driven slowly along by means of a steel worm and wheel. The entire equipment, including the rails, is protected from the weather by being enclosed in the airtight case in which the screens are placed.

The sequence of operations is as follows: The attendant shuts off the exhaust fan, and presses a push button which starts up the rapping and traveling mechanism of the screen vibrator. When the vibrator reaches the farther end of its travel, it automatically engages with a reversing relay switch and commences to return to its starting point. On reaching its original position, it automatically shuts off the current and stops. The exhaust fan may then be re-started, although for the most effective cleaning of the screens it is advisable to allow a few moments to elapse to allow the dislodged dust to settle into the hoppers below the screens.

Powerful Mine Locomotive On Exhibition

The 20-ton Baldwin-Westinghouse haulage locomotive shown at American Mining Congress is the most powerful mine locomotive ever built, having two 150-horsepower motors. This locomotive incorporates the latest refinements of design dictated by results of past operating experience.

On an average 1 per cent grade against the loaded trip this locomotive will haul fifty loaded 2½-ton capacity cars at a speed of 9 miles an hour. The average trip will consist of 40 loaded cars hauled up an average grade of 0.9 of 1 per cent at an average speed of 10½ miles per hour and for a distance of 10,000 feet. This locomotive will be delivered to the Bertha-Consumers Coal Company at Burgettstown, Pennsylvania from the exhibit.

Mundy Appoints

The Mundy Sales Corporation announces the appointment of the Funkhouser Equipment Company, Kansas City, Missouri, as exclusive distributors for that territory. Mr. V. E. Funkhouser is a well known distributor in Kansas City and has been in this field for many years.

The Johnson-Beckwith Machinery Company, Union Bank Building, Davenport, Iowa, has been appointed exclusive distributor for this territory. Mr. Johnson was formerly president of the Davenport Locomotive Works and Mr. Beckwith, his associate, was also with this company.

New Lift-Truck Platform

The Barrett-Cravens Company recently issued a catalog, covering their lines of "Steeleg" platforms, and featuring special types for special applications—table type for assembly benches—Al-Way with the four way lift-truck entry feature for crowded aisles—live type on casters—box and sling types.

Construction varies, depending upon the average loads to be sustained. Top boards and truck guides are of hard maple, the running supports being carried the full length of the platform, so that regardless of type long service and the ability to withstand everyday rough shop treatment are built into each unit.

Prest-O-Lite Company Sells Storage Battery

The Prest-O-Lite Company announces the sale of the storage battery branch of its business to a new company, Prest-O-Lite Storage Battery Corporation. The entire capital stock of the purchasing company is owned by the Automotive Battery Corporation. of New York. That portion of the Indianapolis plant of the Prest-O-Lite Company, Inc., used for the manufacture of storage batteries has been leased to the new company.

Kensington Steel Appoints

The Kensington Steel Company announces the appointment of Arthur Whitcraft as Eastern sales manager with headquarters at Port Ewen, New York. Mr. Whitcraft has been engaged in the manganese steel foundry business continuously during the past seventeen years. His experience includes engineering, sales, and the operation of manganese steel foundries, employing both the converter and the electric furnace processes.

Bucyrus Company Opens Branch Office

The Bucyrus Company announces the opening of a branch sales office and repair parts depot at 1737 East 7th Street, Los Angeles, California. Mr. J. H. Sackett will have charge of sales in southern California, under the direction of Mr. P. H. Birckhead, Western sales manager. Mr. W. O. Hahn will have charge of the repair parts depot.

Harnischfeger Corporation announces the opening of a Baltimore office at 1402 Lexington Building, under the management of Mr. Daniel J. Murphy, formerly manager at Dallas, Texas.